

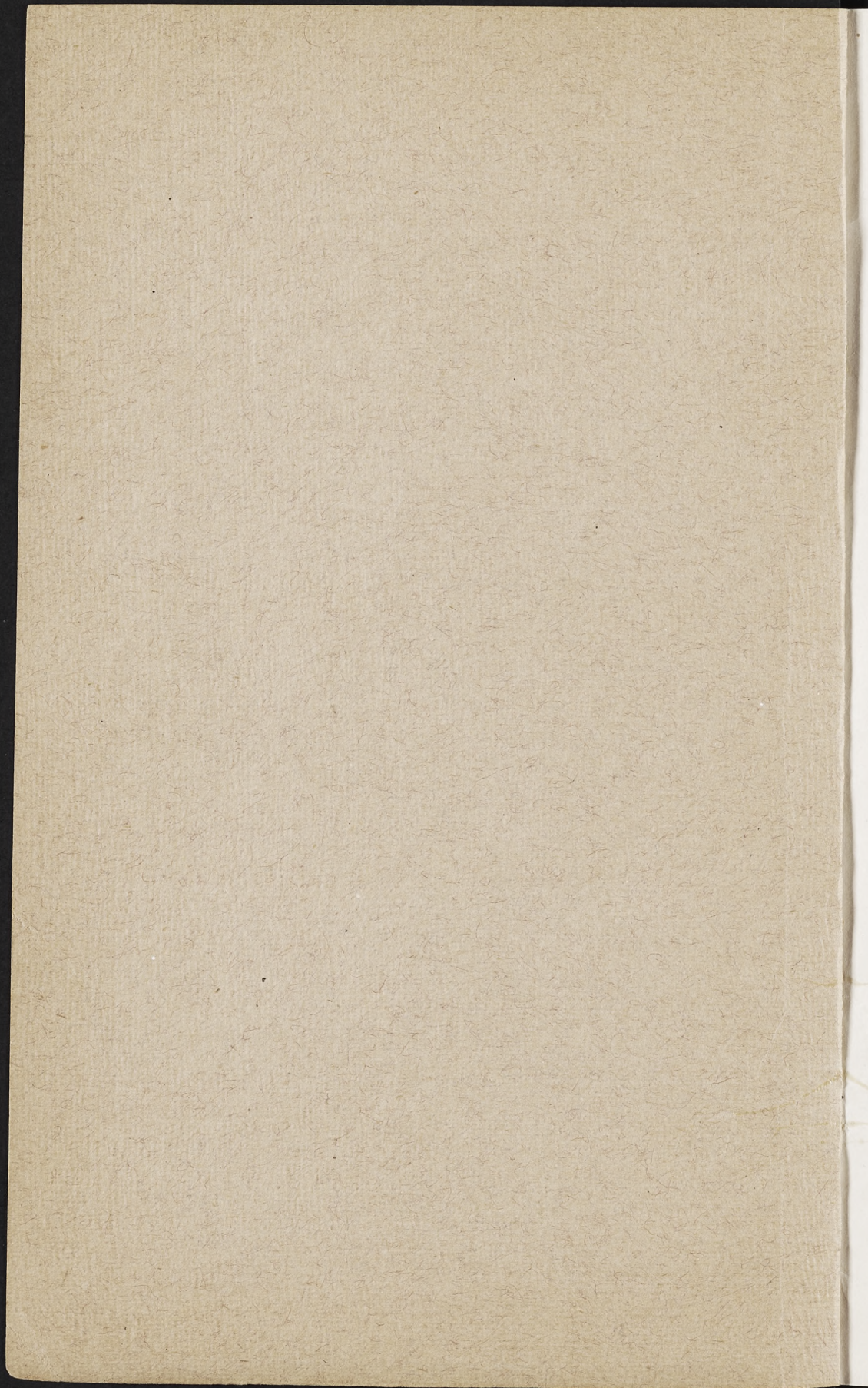
REPORT

on South San Joaquin Irrigation District

FINDINGS OF THE IRRIGATION
DISTRICT BOND COMMISSION
AFTER INVESTIGATION OF
THE BONDS OF THE SOUTH
SAN JOAQUIN IRRIGATION
DISTRICT



BY
Irrigation District Bond Commission



REPORT
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REPORT

—ON—

South San Joaquin Irrigation District

—BY—

Irrigation District Bond Commission

FINDINGS OF THE IRRIGATION DISTRICT BOND COMMISSION AFTER INVESTIGATION OF THE BONDS OF THE SOUTH SAN JOAQUIN IRRIGATION DISTRICT.

Pursuant to the provisions of an Act of the Legislature of the State of California entitled "An Act relating to the bonds of Irrigation Districts, providing under what circumstances such bonds shall be legal investments for funds of banks, insurance companies and trust companies, trust funds, state school funds and any moneys or funds which may be now or hereafter be invested in bonds of cities, cities and counties, counties, school districts or municipalities and providing under what circumstances the use of bonds of Irrigation Districts as security for the performance of any act may be authorized," approved June 13, 1913, and

Pursuant to the resolution of the Board of Directors of the South San Joaquin Irrigation District passed August 12, 1913, requesting the approval of the Commission provided for in the Act of an issue of bonds already authorized to the amount of \$1,875,000, and of an issue of bonds already authorized to the amount of \$1,960,000,

We, the undersigned members of the Commission provided for in said Act, do hereby make the following report:

That we hereby adopt as a basis of the findings herein contained the report of the Irrigation Bond Commission made May 13, 1913, after due investigation of the South San Joaquin Irrigation District and we find as follows:

(a) That the supply of water available for the project amounts to an annual average flow of two and one-half acre feet for the irrigable area of the District; that the right of the District to this amount of water is established.

(b) That the soil of the District is fertile and susceptible to irrigation. That the requirements will not exceed two and one-half acre feet of water per year. That no portion of the District now needs drainage, but some portions will require drainage soon after irrigation begins. That the plans of the District provide for a complete drainage system.

(c) The District's irrigation system projected and partially completed is entirely feasible and can be completed at a cost of \$1,960,000.

(d) That the reasonable market value of water, water rights, canals, reservoirs, reservoir sites and irrigation works owned by said District or to

be acquired or constructed with the proceeds of the said issues of bonds is \$3,460,000.

(e) That the reasonable market value of the land included within the boundaries of the District is \$8,288,416.

(f) That the aggregate amount of outstanding bonds of the said District, including bonds authorized but not sold, does not exceed 60 per cent of the aggregate market value of the lands within the said District and of the water, water rights, canals, reservoirs, reservoir sites, owned or to be acquired and constructed with the proceeds of the said bonds, but only covers 32.64 per cent of the value of such lands and water rights.

(g) That the numbers, issues and denominations of the bonds which are available for the purposes defined in Section 7 of the said Act are as follows:

ISSUE JULY 1, 1910.

Series	No.	Numbered	Coupons	Time	Maturity	Amount
1	188	1 to 187 @	\$500.00	42	21 July 1, 1931	\$93,500.00
		188 @	250.00	42	21 July 1, 1931	250.00
2	225	189 to 413 @	500.00	44	22 July 1, 1932	112,500.00
3	263	414 to 675 @	500.00	46	23 July 1, 1933	131,000.00
		676 @	250.00	46	23 July 1, 1933	250.00
4	300	677 to 976 @	500.00	48	24 July 1, 1934	150,000.00
5	338	977 to 1313 @	500.00	50	25 July 1, 1935	168,500.00
		1314 @	250.00	50	25 July 1, 1935	250.00
6	375	1315 to 1689 @	500.00	52	26 July 1, 1936	187,500.00
7	413	1690 to 2101 @	500.00	54	27 July 1, 1937	206,000.00
		2102 @	250.00	54	27 July 1, 1937	250.00
8	488	2103 to 2589 @	500.00	56	28 July 1, 1938	243,500.00
		2590 @	250.00	56	28 July 1, 1938	250.00
9	563	2591 to 3152 @	500.00	58	29 July 1, 1939	281,000.00
		3153 @	250.00	58	29 July 1, 1939	250.00
10	600	3154 to 3753 @	500.00	60	30 July 1, 1940	300,000.00
						<hr/>
						\$1,875,000.00

ISSUE APRIL 18, 1913.

Series	No.	Numbered	Coupons	Time	Maturity	Amount
1	585	1 to 585 @	\$100.00	43	21 April 18, 1934	\$58,500.00
2	280	586 to 865 @	250.00	45	22 April 18, 1935	70,000.00
		866 to 867 @	100.00	45	22 April 18, 1935	200.00
3	167	868 to 1030 @	500.00	47	23 April 18, 1936	81,500.00
		1031 to 1034 @	100.00	47	23 April 18, 1936	400.00
4	188	1035 to 1221 @	500.00	49	24 April 18, 1937	93,500.00
		1222 @	100.00	49	24 April 18, 1937	100.00
5	210	1223 to 1432 @	500.00	51	25 April 18, 1938	105,000.00
		1433 to 1435 @	100.00	51	25 April 18, 1938	300.00
6	234	1436 to 1669 @	500.00	53	26 April 18, 1939	117,000.00
7	259	1670 to 1926 @	500.00	55	27 April 18, 1940	128,500.00
		1927 to 1928 @	100.00	55	27 April 18, 1940	200.00
8	304	1929 to 2232 @	500.00	57	28 April 18, 1941	152,000.00
		2233 @	100.00	57	28 April 18, 1941	100.00
9	351	2234 to 2584 @	500.00	59	29 April 18, 1942	175,500.00
10	376	2585 to 2958 @	500.00	61	30 April 18, 1943	187,000.00
		2959 to 2960 @	100.00	61	30 April 18, 1943	200.00
						<hr/>
						\$1,170,000.00

ISSUE JULY 1, 1913.

Series	No.	Numbered	Coupons	Time	Maturity	Amount
1	79	1 to 79 @	\$500.00	42 21	July 1, 1934	\$39,500.00
2	94	80 to 173 @	500.00	44 22	July 1, 1935	47,000.00
		174 to 177 @	100.00	44 22	July 1, 1935	400.00
3	115	178 to 287 @	500.00	46 23	July 1, 1936	55,000.00
		288 to 290 @	100.00	46 23	July 1, 1936	300.00
4	128	291 to 416 @	500.00	48 24	July 1, 1937	63,000.00
		417 to 418 @	100.00	48 24	July 1, 1937	200.00
5	143	419 to 560 @	500.00	50 25	July 1, 1938	71,000.00
		561 @	100.00	50 25	July 1, 1938	100.00
6	158	562 to 719 @	500.00	52 26	July 1, 1939	79,000.00
7	177	720 to 892 @	500.00	54 27	July 1, 1940	86,500.00
		893 to 896 @	100.00	54 27	July 1, 1940	400.00
8	207	897 to 1101 @	500.00	56 28	July 1, 1941	102,500.00
		1102 to 1103 @	100.00	56 28	July 1, 1941	200.00
9	237	1104 to 1340 @	500.00	58 29	July 1, 1942	118,500.00
10	252	1341 to 1592 @	500.00	60 30	July 1, 1943	126,000.00
		1593 to 1596 @	100.00	60 30	July 1, 1943	400.00

\$790,000.00

Respectfully submitted,

U. S. WEBB,
Attorney General.

W. F. McCLURE,
State Engineer.

W. R. WILLIAMS,
Superintendent of Banks.

Dated: September 17, 1913, San Francisco, California.

Pursuant to the provisions of an Act of the Legislature of the State of California entitled "An Act relating to bonds of irrigation districts, providing under what circumstances such bonds may be made legal investments for the funds of banks, banking associations, trust companies, insurance companies, and for the state school funds and trust funds, and providing for the deposit of such bonds for public moneys, and providing for a commission for approving certain bonds of irrigation districts, for a report thereon, for the filing of such report, for a certificate of the state controller, and for the recording of such bonds in the office of the state controller," approved December 18, 1911, and

Pursuant to resolutions of the board of directors of South San Joaquin Irrigation District passed respectively December 10, 1912, and April 22, 1913, requesting the approval of the commission provided for in the act of an issue of bonds already authorized to the amount of one million eight hundred and seventy-five thousand dollars and of an issue of bonds already authorized to the amount of one million nine hundred and sixty thousand dollars,

We, the undersigned members of the Commission provided for in said act, do hereby make the following report:

Having caused an investigation to be made of the affairs of the district, the results of which investigation are set forth in the appendix hereto, we find as follows:

(a) That the reasonable market value of water, water rights, canals, reservoirs, reservoir sites and irrigation works owned by said district or to be acquired or constructed with the proceeds of the said issue of bonds is-----\$3,460,000

(b) That the reasonable market value of the land included within the boundaries of the district is-----\$8,266,416

(c) That the project for which the proceeds of the proposed issue of bonds are to be used is physically feasible at an approximate cost of-----\$1,960,000

Respectfully submitted,

U. S. WEBB,

Attorney General.

W. F. McCLURE,

State Engineer.

W. R. WILLIAMS,

Superintendent of Banks.

Dated San Francisco, California, May 13, 1913.

South San Joaquin Irrigation District Engineering Examination

PART I.

May 13, 1913.

The South San Joaquin Irrigation District was organized in 1909, under the provisions of the Irrigation District Law of 1897, and amendments thereto.

LOCATION.

It lies wholly in San Joaquin County, the boundaries being here described as follows:

Beginning at the east boundary line of San Joaquin County, on the north, or right bank of Stanislaus River, thence following near the right bank of the River Southerly and Westerly to the South line of Township 2 South, Range 7 East, thence West and North along section, or subdivision, lines to the Western Pacific Railroad, near Lathrop, thence North along the east side of the railroad to a point near French Camp, thence in a general Southerly and Easterly Direction to the County Boundary; thence South to the place of beginning.

The area, as finally adjusted and approved, includes parts of Township 1 South, Ranges 7, 8, and 9 East, and Township 2 South, Ranges 6, 7, 8, and 9 East, Mt. Diablo Meridian, and embraces 71,050 acres.

TOPOGRAPHY.

The land of this District is essentially a level plain of gentle and uniform slope from Southeast toward the Northwest, beginning with an elevation of 150 feet near the Northeast corner, and merging into the flat overflow lands bordering the San Joaquin River at the West end, at about 20 feet above sea level. Transversely across the District the ground surface is slightly rolling in alternate depressions and ridges, but they are not abrupt, and the difference in elevation is small. They have a general direction and trend northwesterly in comparatively straight lines, parallel with the longer axis of the District. This conformation presents admirable conditions for the layout of irrigating and drainage ditches.

The District is not intersected by any large watercourses, but that it was, in prehistoric times, traversed by the Stanislaus River, or an overflow channel therefrom, is evident by the character of the soil throughout the central portion.

SOILS

The soils of the South San Joaquin Irrigation District are rather complex in their composition and distribution. The range in character of soils extends from sands, coarse and fine, through loams of several types, clays, and silts to adobe. There are probably a dozen types which might be classified, each possessing some characteristics distinguishing it from the others, but for the purposes of this discussion, only four dominating types will be considered, to-wit:

- (a) Sandy Soil.
- (b) Red Loam.
- (c) Coarse Sandy Loam.
- (d) White-Ash Land.

In common with most of the Valley lands, the soils of this District were probably deposited under the waters of the ancient lake which occupied the Great Interior Valley during the Pleistocene period. They were brought down by the floods of the Stanislaus River from the disintegrated granite quartz and porphyries of the high Sierras. After the waters of the lake receded, the soils were modified by admixture of matter derived from weathering of sedimentary formations in the hills. A source of much of the fine cementing material, as well as the alkali content of the soils was probably the deposit of andesitic tufa discernible in outcrops at the edge of the valley.

CHARACTERISTICS AND DISTRIBUTION OF SOILS.

(a) SANDY SOIL:

This is a fine, loose micaceous sand of granite origin, light or yellowish brown in color, slightly darker on exposed surface. It is quickly distinguishable by its refusal to pack under wheeled traffic, roads over it always remaining "sandy." It has a strong tendency to drift under the influence of the wind into ridges and dunes of considerable extent and height. Its migratory habit frequently proves disastrous to young vines and other crops, but with irrigation is very productive, and with good crop binders it ceases to travel. Being incoherent and friable, it is easily cultivated. When hardpan exists at shallow depths, the soil is likely to contain some alkali, and with injudicious irrigation quickly becomes waterlogged.

This type is most abundant in the district, and probably embraces a third of the entire area. Beginning at the eastern boundary it is found in detached patches and strips extending westward through the central portion of the District. Another body begins about Ripon, extends Westward and then North joins the other body at the Southern Pacific Railroad, near the station of Morrano, and occupies nearly the whole area about Manteca and North and West to the District boundaries. This soil is well adapted to the raising of peaches, olives, almonds, grapes, sweet potatoes, melons, berries, alfalfa and garden truck. As above indicated, however, irrigation must be practiced with judgment, and coupled with drainage.

(b) RED LOAM:

This soil is a close-grained sandy loam, the sand being sharp and causing a harsh "feel" when rubbed between the fingers. The prevailing

color is brick red, but sometimes brownish or mottled gray. When the moisture content is just right, it is friable and easily worked, but when wet is extremely tenacious, and upon drying becomes very hard, cracks and shows strong adobe characteristics. It is always underlain at depths of one to five feet by a hard ferruginous hardpan, varying from a few inches to several feet in thickness. Alkali does not occur in this soil in appreciable quantities. In the early grain-growing days of the State this type was cultivated to that industry. Owing to its sticky nature when wet, and the nearness of the hardpan, it is a difficult soil to irrigate but where water is judiciously applied, and skill employed in cultivation, it is tractable. Its best crops seem to be grains, beans and other shallow-rooted crops, but with two and one-half or three feet depth of soil, grapes do well. The only area occupied by the red loam is several sections in the northeast corner of the District, and a narrow strip extending several miles along the northern border.

(c) COARSE SANDY LOAM:

This type is a coarse, sharp sand and fine sharp gravel of granite and quartz origin. The voids between the grains is filled with silt and fine micaceous sand. The texture is not uniform, some breaking into large pieces when plowed, while the greater portion is loose when dry, though inclined to be quite sticky when wet. It packs firmly, and makes an excellent roadbed.

A narrow strip of this soil enters the District near the northeast corner, meanders through the body last above described to Escalon, where it terminates. A short distance southwest of Escalon is an irregularly shaped body of it, and south of this body begins the largest area of this type to be found in the District. Commencing in Section 17, this area extends westward in a body nearly two miles wide and ten miles long, with arms stretching toward the northwest and west. The stations of Weston and Morrano, on the Southern Pacific Railroad, are both located in this area, although a strip of type (a), described above, and a sand dune intervenes between them. Several detached areas also lie along the west boundary of the District. The area of this type probably marks a Pleistocene overflow channel of the Stanislaus River.

This soil is free from alkali and hardpan, and lends itself readily to cultivation under irrigation. It is adapted to growing almonds, olives, citrus fruits, vegetables, melons and especially strawberries, raspberries, blackberries and grapes.

(d) WHITE ASH LAND:

This type is composed of rather fine, sharp granite sand, silt and clay. The color is gray, light brown and light chocolate brown. Its ashy gray color gave it the name of white ash land in Fresno and Tulare Counties, where it is very abundant. At a depth of two to five feet it is frequently underlain with a stratum of fine silt, resembling the laitance washed out of hydraulic cement by too much water used in mixing. It may be only a few inches thick, or it may extend several feet down. Sometimes it is quite soft, and at others it is cemented by carbonate of lime into an impervious hardpan. Where sufficient depth obtains, alfalfa, grains, vegetables, and all fruits, but citrus, thrive well on it, and it is one of the easiest soils to cultivate under irrigation. Owing to the presence of lime in the subsoil, citrus fruits do not usually do well.

A considerable body of this soil extends westerly through the central portion of the District between the areas of red loam and sandy soil, encircling Escalon and thence northwesterly through the northern portion.

Another large area lies in the southwestern part of the District, from Ripon westerly.

ALKALI.

At various points throughout the western portion of the District evidences of alkali in the soil are found. It is mostly confined to small, scattered areas, and is wholly in Ranges 6 and 7. A close examination shows that the amount of alkali is not as great as appearances indicate, owing to a concentration at the surface, and which can be largely eliminated by proper manipulation.

Its presence, however, in any quantity, emphasizes the need for watchful care in the application of irrigation and the early installation of adequate drainage, else deplorable conditions will supervene just as has occurred in other irrigated territory.

CROPS IN GENERAL.

Practically the whole territory embraced within the District has been "farmed" for nearly half a century. Nearly all of it was cultivated for wheat in the heyday of that industry, but later, other and more intensive cultivation was introduced, and under the stimulus of the advent of the Tulloch Irrigation System, several orchards, extensive vineyards and alfalfa fields were planted, and in spite of the poor service given by the ditches, people have prospered. Some of the vineyards and orchards have thrived and yielded fairly well without irrigation, though all alfalfa and small crops must be irrigated.

CLIMATE.

This district being a part of the Great Valley has the climate peculiar to that section, consisting of two seasons, winter, or rainy season, and summer, or dry season. The winters are made up of rainy and foggy weather, seldom of long duration, interspersed with clear warm days. The temperature of winter sometimes is several degrees below freezing, necessitating warm clothing and fires in the houses, but never is cold enough to prevent outdoor work. The summers are dry and cloudless, only about ten per cent of the annual precipitation occurring during the months May to September. A few days may occur when no breeze prevails, that the thermometer registers as high as 110 degrees F., but owing to the dryness of the air, no ill effects are felt by normal persons. The annual mean temperature is about 59 degrees Fahrenheit.

There are no records at hand of the rainfall within the District, but the U. S. Weather Bureau records for Lathrop on the west, show the average for the years 1907-1912 to be 11.67 inches, and the record kept by the Oakdale Milling Company, at Oakdale, on the east of the District, for twenty-three years, 1885-1908, shows an average annual precipitation of 15.62 inches. The mean of these probably represents a fair estimate for the area within the District, and amounts to 13.5 inches. The variation of rainfall is considerable, from year to year. The record at Lathrop above referred to, shows the maximum and minimum precipitation to have occurred in alternate years, the minimum being about half as much as the maximum.

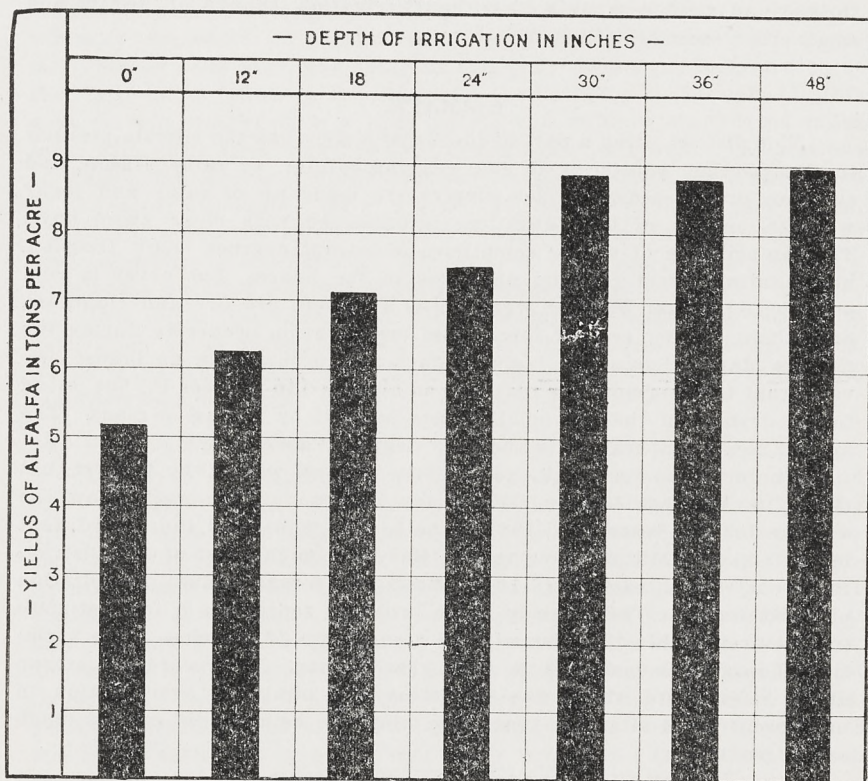
ADVANTAGES OF IRRIGATION.

It has been seen that the rainfall within the District ranges from about 7 to 15 inches a year, in round numbers, and that crops in some

amount can be raised on the lands with the natural rainfall. In the face of the well-known fact that throughout California, water artificially supplied greatly increases the yield of agricultural crops, it would seem unnecessary to discuss that question, but it may be well to cite a few concrete examples.

The U. S. Department of Agriculture, for several years, has been engaged in co-operation with the Department of Engineering, in investigating this subject, and in the last report of the Department is published the result of those investigations. In experiments conducted on the State Farm at Davisville, a record was kept of the yield of alfalfa and of barley in unirrigated land, and on similar soil with the application of water in different quantities. It was found that the value of the crops of barley harvested was increased from 23 per cent to 114 per cent by irrigation. The net profits on the alfalfa crops were increased from 37½ to 61½ per cent by the application of 30 inches in depth of water, by irrigation. In finding the net profit, all costs of production, including purchase of water and cost of applying it, were taken into consideration. These experiments also demonstrated that 30 inches in depth for the lands under experiment was the limit of profitable application, since, while in most cases an increase of water produced a slight increase in the yield, it was in every instance at a cost greater than the revenue, and entailed an actual decrease in profit.

A diagram, showing the crop yield of alfalfa, with different depths of water applied, is hereto attached.



DUTY OF WATER ON ALFALFA—EXPERIMENTAL PLAT—DAVIS 1910 1911 1912

It should be here remarked that the climatic conditions at Davisville and in the South San Joaquin Irrigation District are quite similar.

DRAINAGE.

It has been shown in the discussion of the soils of the District, that most of them require the intelligent use of the water to obtain the best results and must have effective drainage facilities in order to retain and preserve the "life" of the soil; otherwise, disaster to the lands will surely follow. The first named requisite can only obtain through education and experience; the second is mechanical, and must be provided for in the construction and administration of the District. The physical conformation of the lands of the District is admirable for the object, and the plans contemplate a complete system of drainage canals and ditches, the cost of which is included in the estimate for the bond issue contemplated.

STATUS OF THE DISTRICT.

The District was organized in 1909. Bonds to the amount of \$1,875,000.00 were issued. Surveys were made for an irrigation system and plans therefor worked out.

Notices of appropriation of water from the Stanislaus River were filed as provided by law. Coincident with the steps taken by this District to acquire water, the Oakdale Irrigation District was organized and began efforts to the same end, for its benefit.

An appropriation of a portion of the waters of the Stanislaus River was held by the Consolidated Stanislaus Water and Power Company under rights dating back several years, and which operated under the name of Tulloch ditch.

The Tulloch ditch system served about 4,000 acres of land, and had contracts to furnish water to about 6,000 acres. Practically all of this land was included in the Districts, about one-half in each.

A coalition was formed between the two Districts; the Tulloch ditch rights were purchased by the Districts for \$650,000.00, the ownership vesting equally in each; an agreement was entered into by the Districts to divide the waters acquired under the Tulloch system, and the waters of the river up to their joint needs, in equal shares.

With the proceeds of the sale of the bonds, construction was commenced on the works, and prosecuted until the funds were exhausted. Owing to the difficulty encountered in marketing the bonds, long delays were encountered, so that the work of construction was not commenced until late in 1911. In the meantime, cost of labor and materials had greatly advanced. Other contingencies, well understood, but unnecessary to name here, contributed to increase the cost of construction to such a degree that the bond issue proved inadequate, and a second issue of \$1,960,000.00 was authorized.

It is this second issue that is made the reason for this investigation.

THE DISTRICT'S IRRIGATION WORKS.

The plans for the Works to obtain water from the Stanislaus River, and deliver it to the lands of the Irrigation District were prepared, and the construction of the Works, so far as it has progressed, has been superintended by the engineering firm of Duryea, Haehl & Gilman, under the direction of Mr. Edwin Duryea, Jr., Mem. Am. Soc. C. E., Chief Engineer.

These plans, submitted to the Commission for examination, include maps of the District, exhibiting topography by contour lines of one foot vertical intervals; maps showing the different lines surveyed for the diversion canal, and of the delivery canal from the reservoir to the District, together with maps showing the entire system of distributing canals and ditches throughout the District.

In addition to the topographic maps of the District, showing surface configuration, contours are also platted, showing variations in the depth to underground water. This information will be found useful in designing a drainage system, the main features of which have already been outlined from these data.

An exhaustive study of storage possibilities in the high mountains has also been made, as well as surveys of other possible reservoir sites in the plains, all of which is treated of in the maps and reports submitted by the engineers.

Elaborate plans and sections for the diversion dam, headworks, canals, tunnels, gates, flumes, siphons, bridges, and various structures required, plans and maps for the dam and storage reservoir adopted, with its accessories, all worked out in great detail, preceded the work of construction. The completeness of the plans and drawings indicates that a very great deal of research and study was given to the project to finally determine the size, character and type of each part of the scheme, as well as the best location for the works in their entirety. It is safe to say that in but few, if any, public or private irrigation enterprises of large size has the engineering study and work been so thoroughly done, and the plans formulated upon such complete engineering data as has the project of the South San Joaquin Irrigation District. The District is to be congratulated, and it may be assured that the ultimate smooth working of the whole will be demonstration of the wisdom of building upon well-digested plans.

The works may be divided for study into divisions, as follows:

1. Diversion dam and headworks.
2. Diversion canal from dam to reservoir.
3. Storage reservoir.
4. Delivery canal from reservoir to District.
5. Distributing system of canals and ditches.

At the time of making the physical examination hereunder the status of the works was as follows:

- The dam and headworks completed.
- The diversion canal fully 80 per cent completed.
- The delivery canal about 70 per cent completed.
- The distributing system only just begun.
- The reservoir not commenced.

A description of the works as designed, and now under construction, here follows:

DIVERSION DAM AND HEADWORKS.

The dam is located on the Stanislaus River, about two and a half miles above Knight's Ferry, and about one and three-fourths miles below the dam and headworks of the San Joaquin Canal and Irrigation Company's canal, commonly known as the Tulloch ditch.

The dam, named "Goodwin Dam," in honor of Mr. B. A. Goodwin, President of the Board of Directors of the District, is built of concrete, in two arched sections of unequal length and height, the buttress between the two arches being a rock ledge rising out of the bed of the stream. The main arch is 78 feet high, 12 feet thick at the base, 8 feet at the top, with an overhanging lip, making the width of crest $10\frac{1}{2}$ feet. The radius of the extrados at bottom is 135 feet. No reinforcing was used in the dam, excepting in the crest. The smaller section is about two-thirds the length of the main dam, and only a little more than 40 feet in height. Inasmuch as the smaller section is of the same thickness as its larger

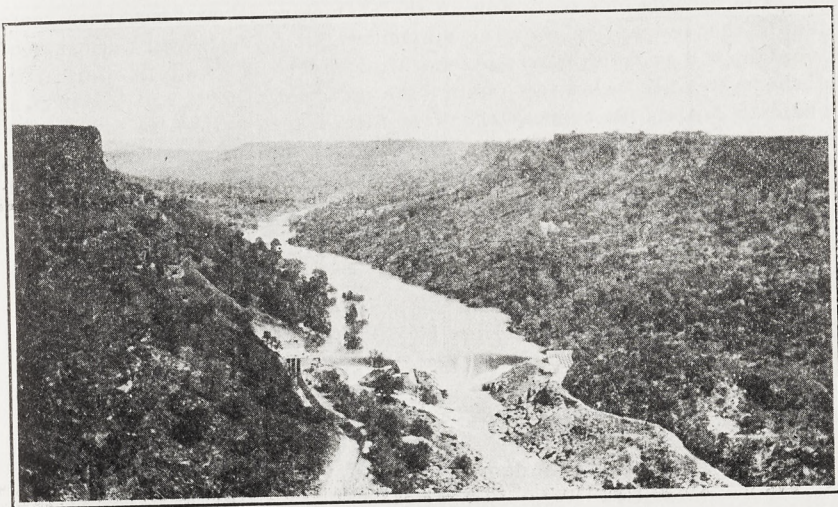


FIG. 1. General View in Stanislaus River Canyon, showing the Goodwin Diversion Dam of the South San Joaquin and Oakdale Irrigation Districts. In the center left is the joint canal of the two Districts; on the right, the separate ditch of the Oakdale Irrigation District.

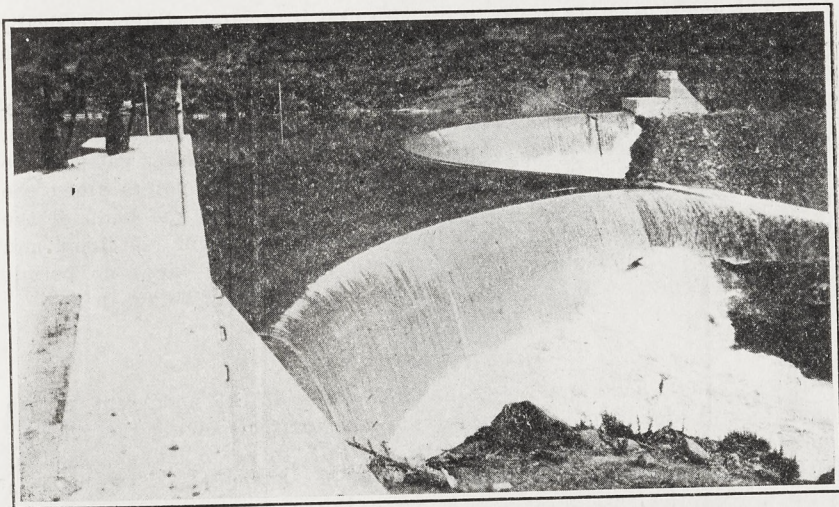


FIG. 2. Looking South from the top of the Joint Headworks along the crest of the Goodwin Dam, showing the water passing over the two arches. The Oakdale Headworks in the background.

neighbor, it may be assumed that calculations need only be made for the latter.

The records of stream flow in the Stanislaus River for twenty years justify the assumption that the maximum flood depth over the crest of the dam will probably never exceed fifteen feet. A small auxiliary dam, a short distance below the main arch, creates a pool, and a sufficient quantity flowing to overtop the dam fifteen feet will raise the stream below a corresponding amount. Allowing for all probable contingencies, a head of 76 feet from the flood plane above the line of strain, the computations then become thus:

$$S = \frac{RP}{b} = \frac{RHw}{b}$$

S = Stress in tons per square foot.

R = Radius of extrados of arch=135 ft.

P = Pressure in tons per sq. ft.=Hw.

H = Head—height from surface below to surface above dam=76.

w = Weight of 1 cubic foot of water in tons=.03125.

b = Thickness of arch at base.

Then for the Goodwin dam:

$$S = \frac{RHw}{b} = \frac{135 \times 76 \times .03125}{12}$$

$$= 26.7 \text{ tons per square foot.}$$

$$= 371 \text{ lbs. per square inch.}$$

which is greater than in some dams, but much below the stresses found in existing dams of proved stability.

The dam raises the water into the canal at the same elevation that had been attained by the Tulloch dam, diverting nearly two miles farther up-stream, and in addition to diverting the water into the canal of the South San Joaquin District, it also diverts into the main canal of the Oakdale District, on the opposite side of the river.

The headworks are of concrete, with cast iron gates, sliding vertically between concrete piers, and operated by geared hand-wheels, working on screw-stems.

A short distance below the entrance gates is a sand sluice and wasteway, discharging into the river through the concrete wall of the ditch. The outflow is controlled by gates in the discharge and other gates in the canal. Other sand sluices are introduced at favorable points along the canal. Safety appliances have been introduced, too, in the bank of the canal along the river canyon, being notches each several feet long, and about two feet in depth, in the concrete wall of the canal, to permit water to escape in case of a slide into the canal forming a dam in it.

DIVERTING CANAL.

The canal, beginning with the headworks at the north end of the dam, follows along the side hill, for the most part displacing the old Tulloch ditch. It is placed further into the hill, so as to make excavated ditch or tunnel, where the former had used wooden flumes. It is in this stretch that the safety escapes referred to are placed. At engineer's station 141, or 2.67 miles from the head, the canal leaves the line of the Tulloch ditch, and by a tunnel 3500 feet in length passes through the ridge into a ravine on the other side. By this route the canal is considerably shortened, and avoids a long stretch of expensive flume along the faces of several cliffs, encountered by the Tulloch ditch.

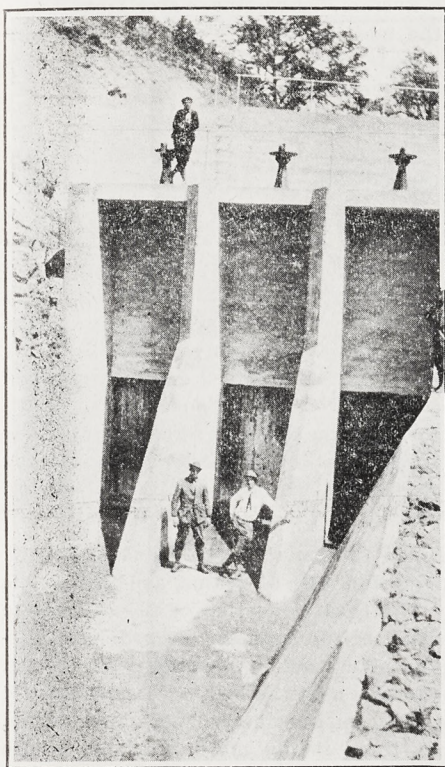


FIG. 3. Regulator Gates on the Joint Canal of the South San Joaquin and Oakdale Irrigation Districts. In the background can be seen the top of the Headworks Dam.

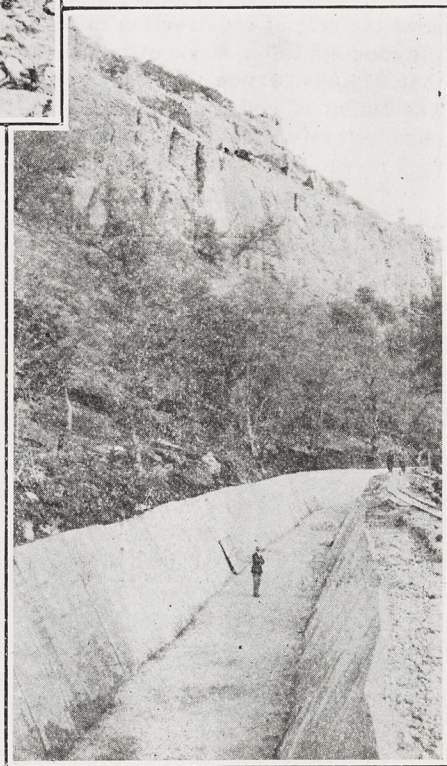


FIG. 4. A Section of the Lined Canal in the Stanislaus River Canyon. This Canal is the joint property of the South San Joaquin and Oakdale Irrigation Districts, and has a carrying capacity of 1110 cu. ft. per second and a velocity of about 8 ft. per second.

Emerging from the long tunnel, the canal follows down the bed of the ravine mentioned to the crossing of the same by the Schell ditch. This ditch was part of the "Tulloch System," diverting water from Little John Creek, and passing through the main ridge between the creek and Stanislaus River, and was used to irrigate lands in the vicinity of Knight's Ferry. Its capacity was about 7 cubic feet a second.

The canal to this point has been designed to carry 850 second feet for the South San Joaquin District and 260 second feet for the Oakdale District, the cost of construction being borne by the Districts in proportion to their respective interests. But here the two Districts divide their water by means of concrete division gates, the Oakdale water being carried through the Schell ditch tunnel (enlarged) and turned into Little John Creek, from which it is recovered lower down. The South San Joaquin District Canal continues westerly, alternately in the rough cut on the ridge and side hill cut on the slopes, with tunnels as required. At $6\frac{1}{4}$ miles from the head the line of the canal crosses a deep depression called "Hilt's Sag," where the water is carried across in a wooden flume 2,000 feet long, on a wooden trestle about 68 feet maximum height. About four and a half miles further the canal terminates in a shallow ravine leading to the proposed reservoir site. This reservoir has been named "Woodward Reservoir," in honor of Director Woodward, who discovered the site.

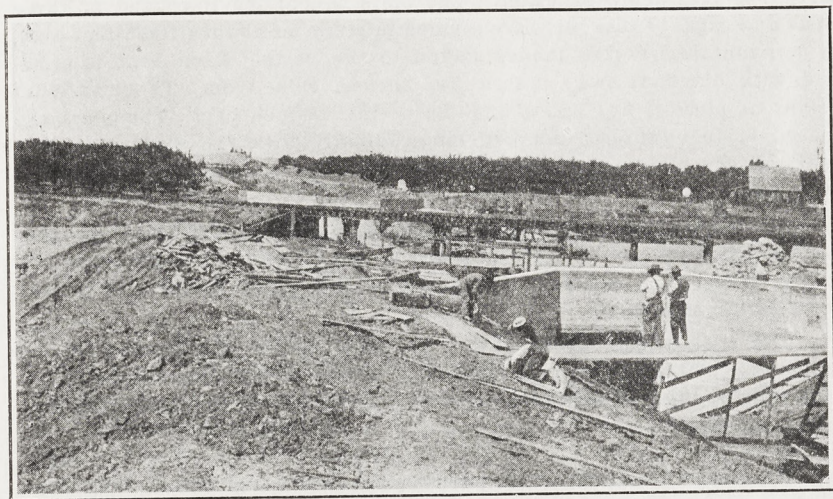
Along the side of the river canyon the canal is excavated largely in rock. The formation is badly broken and full of seams, frequently the stratification being nearly vertical. The greater portion of the canal here is lined with concrete, as are also many of the tunnels. In order to minimize the cost of construction in many places where the rock was firmest, the concrete lining was omitted on the side next the hill. It was estimated that \$15,000.00 was thus saved in the cost of constructing this portion. The lining is nominally four inches thick, being more in places where outside forms were omitted, and where the inequalities of the broken out rock recede from the construction lines.

The form of the canal is that of a trapezoid, carrying 8.33 feet depth of water and the other dimensions adjusted to preserve a prescribed flow, according to the grades fixed by the conditions of construction.

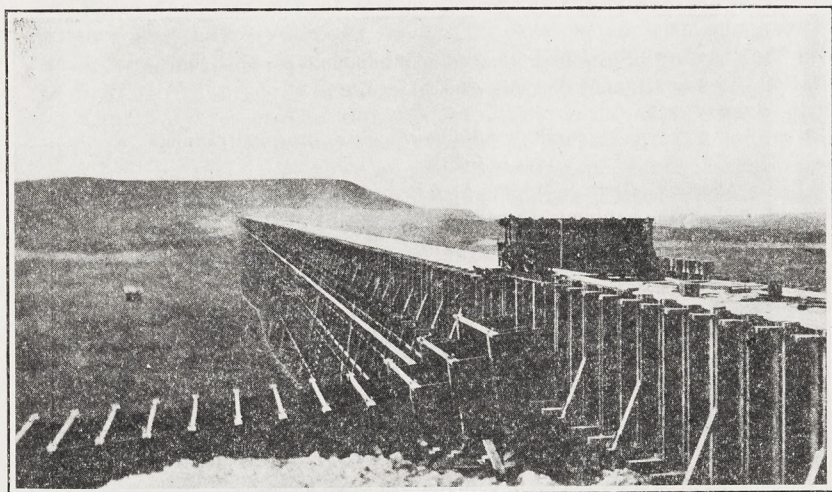
In solid rock frequently the dimensions adopted were 13.92 feet bottom width, 16.50 feet top, both inside measurements, and 10.33 feet deep, the concrete being carried two feet above the intended water line. These dimensions give a side slope of about 1 to 10. In softer material the dimensions are narrower bottom, flatter slopes and wider top, but all of values to preserve the functions of uniform flow. For the most part, the canal has been kept in excavation, and usually so that the water surface shall be below the natural surface of the ground. This method is more expensive than were the canal so made that the material excavated would create banks to hold the water partly above ground, but the saving of seepage loss should, in the course of time, compensate for the greater expense, besides eliminating danger of breaks in the canal banks, which frequently occur with the other type of canal.

Where it was deemed impracticable to locate the line in cut, as in crossing depressions below grade, the necessary fills appear to have been made with great care, precaution being taken to obtain suitable material, even from considerable distances, and to thoroughly compact it in place.

The Hilt's Sag Flume, heretofore mentioned, is a wooden box, supported upon wooden trestles, a description and analysis of which is here presented.



View of Inlet End of Siphon on the Main Supply Canal under the Southern Pacific Railroad, the County Road and Lone Tree Creek, near Thalheim, Calif.



Hilt's Sag Flume, with Waste Way in the foreground.

HILT'S SAG FLUME.

The box is 14 feet 7½ inches wide, inside at bottom, and intended to carry 7½ feet depth of water. The piers supporting it consist of three posts and caps. These piers are divided into stories about fifteen feet high, by horizontal girts 2x8 inches spiked to the posts. Each bent is cross-tied with diagonal sway braces, 2x8 inches, spiked on. The maximum height of piers is 64 feet to the top of the 14-inch cap. The piers are spaced 12 feet centers, and tied longitudinally with 2x8 girders at each bent. Every eighth span is sway-braced, so as to make a tower of the two piers.

The sides of the flume are 3 inches thick for the first 3 feet up from the bottom; the next 3 feet they are 2 inches, and the remainder 1½ inches thick. The cross-sectional area of the water prism at 7½ feet depth is 110 square feet.

The posts are continuous, but as above stated, are divided by the supporting points of the girts and sway braces into lengths of about 15 feet, and for the purposes of computation here, that will be the length of column adopted.

The load to be carried by the bottom panel of each high pier is composed as follows:

Box 12 feet long.....	2438 ft. B. M. of lumber.
Posts, struts and cap of pier.....	1650 " " "
	4088 " " "
Prism of water 110×12=1320 cu. ft. @ 62½ lbs.=	82,500 lbs.
Lumber 4088 ft. @ 3½ lbs.....	14,308 "
Nails, wires, etc.....	2271 "
Total pier load.....	97,079 "
3 posts in each pier, load per post.....	32,359 lbs.

Using a formula published by U. S. Forest Service:

$$(1) \quad U = S \frac{700+15g}{700+15g+g^2}$$

Wherein

U = Ultimate strength of column in pounds per square inch.

S = Ultimate crushing strength of timber.

$g = \frac{l}{d}$ l=length of column in inches; d=smaller dimensions in inches

Section of post or column 6 x 8 inches; d = 6 inches.

Length of column, 15 x 12.....l = 180 "

$$g = \frac{180}{6} = 30.$$

The value of S for Douglas Spruce (Oregon Pine) is given as 6000 lbs.

The above for the case in hand then becomes:

$$U = 6000 \frac{700+15 \times 30}{700+15 \times 30+30^2} = 3366 \text{ lbs.}$$

Area of cross-section of column, 6x8 = 48 inches.

Ultimate strength of post=48x3366=161,568 lbs.

Ultimate strength 161,568

Total load 32,359 = 5, factor of safety

Checking the above by the popular Gordon formula :

$$(2) \quad U = \frac{1350}{1 + \frac{l^2}{1100 d^2}}$$

Wherein U = *safe* unit load in pounds per square inch of cross-section of column, and other elements as in formula (1) above, the solution then becomes:

$$U = \frac{1350}{1 + \frac{180^2}{1,100 \times 6^2}} = 743 \text{ pounds per square inch.}$$

The safe bearing load for post = $743 \times 48 = 35,664$ pounds, a close agreement with (1) above.

The factor of safety, 5.0, is based upon the theory that the girts divide the pier into stable sections of 15 feet each, and will hold the long posts rigid at those points. The slender size of the strut members raises a question whether the above stable condition will obtain under all conditions of load, particularly after deterioration has begun.

It may be stated that the materials used are very excellent in quality, and the workmanship employed in the construction of this flume appears to have been unusually well done.

The structural drawings of the Hilt's Sag Flume were submitted to Mr. A. V. Saph, former engineer for the San Francisco Harbor Commissioners, and his analysis leads him to report the conclusion that the flume is safe under great load, and under a 23-pound wind, excepting that the fastenings of the diagonal sway braces would be subject to a strain beyond the limit prescribed by good practice.

DELIVERY CANAL.

From the dam site of the proposed reservoir, the canal, for convenience designated "delivery canal," is constructed with a capacity of 694 second feet. It runs westerly, and southerly 6.4 miles, and enters the District about a mile south of the northeast corner. At $4\frac{1}{2}$ miles on this canal, it crosses the line of the Stockton-Oakdale branch of the Southern Pacific Railroad. This railroad is paralleled by a county highway. Both of these highways, and the course of the canal are intersected by the channel of Lone Tree Creek. The canal is carried beneath the railroad, the highway and the bed of the creek by means of an inverted, reinforced concrete siphon 350 feet in length over all.

With rare exceptions, the canal is entirely in excavation, the depth being such that the surface of the water will be below the natural surface of the ground. Wherever fills are necessary, the cross-drainage is effected by covered culverts, passing under the canal.

All county roads, and many private ways, cross the canal on substantial wooden bridges, some of which are 40 feet in width. The Oakdale District extends across the delivery canal, and its ditch system crosses by means of wooden flumes.

DISTRIBUTING CANALS.

The distributing system, as planned, contemplates main canals traversing the District on the ridges, with lateral canals taking off at con-

venient points, and these subdivided into distributors so proportioned as to deliver to each forty-acre tract an "irrigation head" of fifteen cubic feet of water per second.

Since fifteen second feet is equivalent to thirty acre feet of water a day, in round numbers, the delivery of that quantity will enable a forty-acre tract to receive its quota of $\frac{1}{2}$ acre foot in sixteen hours continuous run, when the supply may be shifted to another tract.

No other irrigation district, and not more than one private enterprise of magnitude in the State, known to the writer, has installed such complete plans for the equitable distribution and prompt delivery of water to the consumers.

The plans provide that no water shall be drawn directly from the canals for irrigation, but all irrigating heads shall be taken from the distributing ditches, only. This plan gives the management complete control of the distribution, and reduces to a minimum losses and damage due to an irrigator shutting off his supply without giving notice, as well as prevents him from taking water out of rotation, or which he is not entitled to receive.

The proposed canals and ditches have been designed with the intention to provide sections and grades to maintain such velocities as to not erode the banks and bottoms, and at the same time sufficiently great to reduce vegetable growth to a minimum.

Excessive grades are taken up with falls or drops in the canals, and these are located at points of division, so as to combine them with the necessary check gates, to turn the water into branch canals. The drops are patterned after those used in the more recent hydraulic projects of India, and are markedly different from the types heretofore constructed in California engineering works.

THE DISTRICT'S WATER RIGHTS.

Appropriation of water from the Stanislaus River was begun in the early days of mining history. Many ditches were constructed in the mountains, diverting water for hydraulic mining, and for milling purposes.

Many of these early appropriations have ceased, as the mining industry declined, but others have been maintained, and converted to irrigation and the production of electric energy. The abstracts of water rights furnished by the District for this investigation, do not cover any appropriations in the mountains, and the foregoing remarks are based upon general knowledge, derived from other sources.

In August, 1902, a series of measurements was made by the U. S. Geological Survey of the water being diverted by ditches from the Stanislaus River, in the high mountains, with the following results:

A ditch near Robinson's Ferry	12 sec. ft.
Soulsby's Ditch	16 sec. ft.
Tuolumne Electric Power Co.	54 sec. ft.
(Being all of North Fork.)	
Angels (Old Milton) Ditch	67 sec. ft.
(Being all but 1 sec. ft. of South Fork.)	
<hr/>	
Total	149 sec. ft.

At the same time the Tulloch ditch was taking 154 second feet, leaving 166 second feet in the river at Knight's Ferry.

However, the water that has been used in the mountainous regions is not a part of the water of the river measured near the point where the

District diverts, and unless some notice of appropriation has been filed and followed by the work necessary to complete the appropriation, "diligently prosecuted," but not yet completed, and under which a right might be perfected, adverse to the District, it would seem that all measurements recorded of water passing Knight's Ferry indicate the true quantity that might be rightfully appropriated from the river, in that vicinity, subject to any appropriation or riparian rights below.

The only appropriations made and perfected in the vicinity of Knight's Ferry prior to the inauguration of the District's appropriations were those owned by the Consolidated Stanislaus Water and Power Company, whose properties are locally known as the "Tulloch Ditch System." The original location of these rights was made in 1855, and at different times later, enlarged and added to, until the whole system was finally purchased by the South San Joaquin and Oakdale Irrigation Districts, jointly.

The Tulloch System diverted the water from Stanislaus River about one and three-quarters miles above the present diverting dam of the two Districts, and was pertinent to about 6,000 acres of land in Stanislaus, Calaveras, and San Joaquin Counties. All, or nearly all of this land, served by the Tulloch Ditches, is now included in the Districts, about 3,000 acres in each. The owners of the ditch system have, from time to time, made contracts with the landowners for the delivery of water to the land, and the status of those contracts, and their effect upon the distribution of their water to the Districts as a whole, will be treated by the legal member of the Commission. In considering the amount of water available for the use of the District, the water rights obtained by purchase of the Tulloch System are considered as belonging equally to the two Districts, each to handle and distribute its share to all lands within its boundaries, without distinction.

The amount of water annually diverted by the Tulloch Ditches was about 40,000 acre feet, and allowing the same ratio of loss as is allowed in the estimates for the District, if it must be segregated and applied only to the lands holding contracts, will reduce the District's quota of $2\frac{1}{2}$ acre feet about 10 per cent.

WATER SUPPLY.

As just shown, the source of water supply for the District is the Stanislaus River. The following description of the drainage basin of this river is quoted from the report of the California State Department of Engineering for 1912.

"The basin of the Stanislaus River is long and narrow, lying between Tuolumne River Basin, on the south, Calaveras and Mokelumne Basins on the north, and the Walker River Basin on the east, the main Sierras Divide forming the eastern rim for a distance of 25 miles. The drainage area above the valley is 950 square miles.

"The source of the Stanislaus River is a number of small glacial lakes situated among the peaks of the Sierras, which reach an altitude exceeding 11,000 feet. It flows southwestward a distance of 80 miles, entering the San Joaquin Valley at Knight's Ferry, and thence continuing 40 miles further, joins the San Joaquin River about 15 miles west of Modesto. The Stanislaus has three branches, South, Middle and North Fork, the Middle Fork being the largest. The South Fork joins the main stream about 25 miles above the valley, while the Middle and North Forks unite about 8 miles further up, and about 12 miles north of Sonora, Tuolumne County.

"The topography of the basin is rough, possessing along and near the upper rim many high, precipitous and barren peaks. The canyons are deep and rugged, those of South and Middle Fork being 500 to 1,000 feet deep, while the North Fork runs 30 or 40 miles between walls 1,500 to 2,000 feet high.

"But little timber is found above 8,000 feet elevation, excepting around the margin of the lakelets and morain meadows, which are usually encircled with tamarack (*pinus contorta*) and quaking asp (*populus tremulus*). The foothill region is fairly well covered with scrub oak and brush, while the middle portion has a wealth of forest, containing all of the valuable varieties of coniferas. The South Grove of the Calaveras Big Trees are in this basin.

"The precipitation in this basin ranges from about 15 inches a year at the mouth of the canyon to 50 or 60 inches in the higher regions, where it appears mostly in the form of snow.

"Irrigation is practiced very little in the hills, and only to a limited extent in the valley. Probably 40,000 acre feet of water is diverted annually near Knight's Ferry, but projects* are being inaugurated that will take the entire summer flow.

"Several dams were constructed in the upper middle portions of the stream in early days, for mining purposes. They are now used for power development. Other and larger reservoirs are being constructed, or contemplated. Several glacial lakes have been utilized for storage. The minimum flow of the Stanislaus River is capable of producing about 80,000 horsepower, which can be considerably increased by additional storage."

(*) The projects referred to are the South San Joaquin and Oakdale Irrigation Districts.

STREAM FLOW.

The record of stream flow in the Stanislaus River extends back to 1878. Unfortunately the record is not continuous, having several breaks when observations were interrupted, but it nevertheless gives a good basis for estimating the probable amount of water that may be depended upon. The records available are as follows:

November, 1878, to October, 1884, inclusive, by the State Engineering Department, under Wm. Ham. Hall, State Engineer.

June, 1895, to December, 1900, inclusive, by the U. S. Geological Survey. The measurements furnishing these records were made at Oakdale.

From May, 1903, to the present time, measurements and daily records of the stream flow have been made by the U. S. Geological Survey, in co-operation with the State Department of Engineering.

The U. S. Geological Survey and the Department of Engineering, in conducting co-operative measurement of streams, record the flow by climatological seasons, from October to the following September, inclusive. Reducing the records to that seasonal flow, the results are exhibited in the following table:

Year.	Flow, Acre Feet.
1878-79 -----	1,300,000
1879-80 -----	1,630,000
1880-81 -----	1,450,000
1881-82 -----	1,480,000
1882-83 -----	935,000
1883-84 -----	1,710,000
Mean for six years -----	1,417,500

Year.	Flow, Acre Feet.
1895-96 -----	1,340,000
1896-97 -----	1,370,000
1897-98 -----	370,000
1898-99 -----	785,000
1899-00 -----	894,000

Mean of five years -----	951,600
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1903-04 -----	2,010,000
1904-05 -----	844,000
1905-06 -----	2,380,000
1906-07 -----	2,800,000
1907-08 -----	593,000
1908-09 -----	1,899,000
1909-10 -----	1,370,000
1910-11 -----	2,320,000
1911-12 -----	552,000

Mean of nine years -----	1,641,000
--------------------------	-----------

Mean of twenty years -----	1,401,600
----------------------------	-----------

The foregoing is the record of flow of the river for twenty years, divided into three periods of five, six and nine years duration, respectively. It will be observed that the year of smallest recorded flow was 1897-98, during the five-year period of small flow, when 370,000 acre feet of water was registered, and the wettest year was 1906-07, when the flow amounted to 2,800,000 acre feet, or more than seven and a half times the minimum flow, and twice the mean annual flow for the twenty years under observation.

The maximum flow in second feet occurred March 18, 1907, when the gauge showed that the amount of water passing was 57,200 cubic feet per second.

In determining whether a given stream furnishes an adequate supply of water for a specific purpose, as the irrigation of a large tract of land, it is not sufficient to ascertain the mean annual flow of the stream, as will appear herein, later.

REQUIREMENTS OF THE DISTRICT.

The plans of the engineers for the District for supplying it with water are based upon the following conditions, actual and assumed:

The gross area of the District is 71,050 acres. It is assumed that not more than 80 per cent will ever be under irrigation at one time; the other 20 per cent being taken up with towns, roads, fences, farm buildings, and fallow lands. This leaves an area of 56,840 acres as the most that will ever require water during any one year. It is assumed, for the District, that the irrigation will be confined to the summer months, April to September, both inclusive, a period of 183 days.

It is further claimed that the quantity of water to be applied should be three feet in depth, over all the land irrigated, or three acre feet. This would require for the 56,840 acres a total quantity to be applied to the land of 170,520 acre feet, and the canals have been designed for that service.

It is assumed that in diverting the water, and conveying it to the District, a loss of 20 per cent will occur, and another 20 per cent will be lost in delivering and distributing the water to the users. This means that 64 per cent of the water diverted from the river will be available

upon the land, or that it will be necessary to divert 266,438 acre-feet, in order to furnish 80 per cent of the land in the District with three acre feet. The capacity of the canal is 850 second feet, equivalent to 1,683 acre feet per day, and it will require 158 days for it, running full, to divert 266,438 acre feet.

According to the agreement between the two Districts, they are entitled to all of the water they can both divert, when that quantity is in the river; therefore, when there shall be $1,683 \times 2 = 3,366$ acre-feet, or more, reaching the dam, both Districts may fill their canals. But when less than 3,366 acre-feet is available, the South San Joaquin District is entitled to only one-half of the flow, be it much or little. It is evident, therefore, that the District's claim cannot be fulfilled at any time when the river flows less than 3,366 acre-feet a day.

A feature of the plans for the District work to be carried out under the new bond issue is a reservoir heretofore described, which will have a storage capacity of 49,000 acre feet. It is conceded that the losses from evaporation and seepage of the water stored will amount to 10 per cent. This will then leave 44,100 acre feet to be added to the supply. Since the canal must run to its full capacity, when it can get the water, after the season begins, April 1st, the reservoir must be filled during the winter months when the canal is not needed for carrying a daily supply.

The record of spring flow, for the period 1904-1912, inclusive, being the most reliable, and including several years considered unusually dry years, is selected for analysis, to ascertain the quantity of water available for the use of the District.

AVAILABLE SUPPLY.

As previously pointed out, computations for available water made from the yearly mean flow, or even the monthly minimum flow of streams, subject to such sudden changes, as the remittent rivers of the Valley experience, are likely to be in great error. The available supply is the quantity stored from surplus, plus the actual amount that reaches the dam, and which can be diverted. As example:

In July, 1911, the recorded mean daily flow of the river for the month was 3,110 second feet — 191,000 acre feet, being 86,654 acre feet in excess of the carrying capacity of both canals, yet the last six days of the month the total flow was 16,395 acre feet, against 20,196 acre feet combined capacity of the canals. Therefore, though the monthly flow was 86,654 acre feet in excess of the requirements, the available water was 3,801 acre feet less. In June, 1910, the record shows a total flow of 93,400 acre feet, while there is required 100,980 acre feet, but during the first thirteen days the flow was 5,422 acre feet more than the ability of the two canals to divert it. And so on, through the whole series of years comprising the period.

In the following tables are shown for every month of the irrigation season of each year:

The total flow of the river in acre feet at Knight's Ferry.

The quantity available for the two canals.

The quantity to which the South San Joaquin District is entitled (which is found by dividing the total available by two).

Following each annual table are computations of the quantity available at the point of delivery, including storage and after deducting losses, and this quantity is reduced to acre feet, by dividing it by the irrigable area of the District.

The "requirements" is assumed to be twice the carrying capacity of

the South San Joaquin Canal, since it is conceded that the Oakdale District is entitled to an equal amount. The quantity is 850 second feet for each District, or 1,700 second feet for both, equivalent to 3,366 acre feet a day, which amounts to a total of 615,978 acre-feet for the season, April-September inclusive.

The "Total Flow" includes the flow of the Tulloch Ditch.

TABLES

Of Stream Flow and Water Available From Stanislaus River at Knight's Ferry.

(All quantities expressed in acre feet.)

1903.

Month.	Total Flow.	Available.
April -----	**	100,980
May -----	(216,375)	104,346
June -----	212,788	100,980
July -----	39,550	39,550
August -----	8,929	8,929
September -----	2,102	2,102
Total -----	2	356,887
		178,443
Loss in transit, 20 per cent -----		35,686
		142,755
Add storage, 49,000—10 per cent — — —		44,100
		186,855
Loss 20 per cent -----		37,371
		149,480
Net available -----		149,480
		Duty
		149,480
		———— = 2.6 A. Ft.
		56,840

** The record began May 19. There had been copious rains in April, therefore, it is assumed that the flow was ample to have met all requirements for April and May.

1904.

Month.	Total Flow.	Available.
April -----	320,668	100,980
May -----	587,022	104,346
June -----	271,220	100,980
July -----	79,626	66,158
August -----	22,873	22,873
September -----	15,531	15,531
	2	410,868
		205,434
Loss in transit, 20 per cent -----		41,087
		164,341
Add storage -----		44,100
		208,447
Loss 20 per cent -----		41,689
		166,758
Net available -----		166,758
		Duty
		166,756
		———— = 2.9 A. Ft.
		56,840

1905.

Month.	Total Flow.	Available.
April -----	165,100	100,980
May -----	199,650	104,346
June -----	142,300	97,804
July -----	37,690	37,690
August -----	9,223	9,223
September -----	6,129	6,129

Total -----	2	356,172
		178,086
Loss in transit, 20 per cent -----		35,617
		142,469
Add storage -----		44,100
		186,569
Loss 20 per cent -----		37,514
Net available -----		149,055

Duty
149,055
----- = 2.6 A. Ft.
56,840

1906.

Month.	Total Flow.	Available.
April -----	317,000	100,980
May -----	497,000	104,346
June -----	556,000	100,980
July -----	320,000	104,346
August -----	56,000	56,000
September -----	18,400	18,400

Total -----	2	485,052
		242,526
Loss in transit, 20 per cent -----		48,505
		194,021
Add storage -----		44,100
		238,121
Loss 20 per cent -----		47,622
Net available -----		190,499

Duty
190,499
----- = 3.3 A. Ft.
56,840

1907.

Month.	Total Flow.	Available.
April -----	483,000	100,980
May -----	473,000	104,346
June -----	446,000	100,980
July -----	269,000	104,346
August -----	65,800	63,147
September -----	22,500	22,500

Total -----	2	496,299
		246,150
Loss in transit, 20 per cent -----		49,630
		198,520
Add storage -----		44,100
		232,620
Loss 20 per cent -----		46,524
Net available -----		186,096

Duty
186,096
----- = 3.2 A. Ft.
56,840

1908.

Month.	Total Flow.	Available.
April -----	142,000	92,355
May -----	136,000	103,568
June -----	80,900	78,815
July -----	30,800	30,800
August -----	12,800	12,800
September -----	6,960	6,960
Total -----	2	325,308

	162,654	
Loss in transit, 20 per cent -----	32,531	
	130,123	
Add storage -----	44,100	
	174,223	

Loss, 20 per cent -----	34,844	Duty 139,379
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Net available ----- 139,379 56,840 = 2.4 A. Ft.

1909.

Month.	Total Flow.	Available.
April -----	291,000	100,980
May -----	379,000	104,346
June -----	333,000	100,980
July -----	88,500	72,750
August -----	21,200	21,200
September -----	9,520	9,520
Total -----	2	409,776

	204,888	
Loss in transit, 20 per cent -----	40,098	
	164,790	
	44,100	
	208,890	

Loss 20 per cent -----	40,178	168,712
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Net available ----- 168,712 56,840 = 2.9 A. Ft.

1910.

Month.	Total Flow.	Available.
April -----	310,000	100,980
May -----	232,000	104,346
June -----	93,400	77,978
July -----	26,900	26,900
August -----	11,900	11,900
September -----	11,700	11,700
Total -----	2	333,804

	166,902	
Loss in transit, 20 per cent -----	33,380	
	133,522	
Add storage -----	44,100	
	177,622	

Loss 20 per cent -----	35,524	Duty 142,096
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Net available ----- 142,096 56,840 = 2.5 A. Ft.

1911.

Month.	Total Flow.	Available.	
April -----	373,000	100,980	
May -----	406,000	104,346	
June -----	491,000	100,980	
July -----	191,000	100,168	
August -----	34,700	34,700	
September -----	18,000	18,000	
Total ----- 2			459,174
			229,587
Loss in transit, 20 per cent -----			45,917
			183,670
Add storage -----			44,100
			227,770
Loss 20 per cent -----			45,554
			182,216 = 3.2 A. Ft.
Net available -----			182,216
			56,840

1912.

Month.	Total Flow.	Available.	
April -----	50,900	50,900	
May -----	203,000	102,782	
June -----	162,000	86,823	
July -----	17,700	17,700	
August -----	7,650	7,650	
September -----	10,900	10,900	
Total ----- 2			276,755
			138,378
Loss in transit, 20 per cent -----			27,676
			110,702
Add storage -----			42,336
			153,038
Loss, 20 per cent -----			30,608
			122,430 = 2.15 A. Ft.
Net available -----			122,430
			56,840

NOTE—These records show the flow of the season 1911-1912 to have been the lowest since the gates were opened. The flow for the months following the irrigation season of 1911—i. e., October, 1911, to March, 1912—is recorded as follows:

	Acre Feet.
October -----	17,000
November -----	18,900
December -----	17,200
January -----	19,600
February -----	13,900
March -----	31,000
<hr/>	
Total -----	117,600

Had the District's canals been operating, and had it taken its half of all the water flowing every day, during the non-irrigating period, that is, one-half of the total flow of 117,600 acre feet, it would have had as follows:

	Acre Feet.
Diverted -----	58,800
Loss 20 per cent-----	11,760
Delivered reservoir-----	47,040
Loss 10 per cent-----	4,704
Net storage-----	42,336

It is readily seen from the above that even with the storage of all of the water contemplated in such an unusually dry season as the last, the supply will be short of the estimated requirements, but, fortunately, such seasons are of rare occurrence.

Referring back to the foregoing tables of flow, it will be observed that the available flow has never been less than 2.4 acre-feet of water but once in ten years. It has also been shown in a former paragraph, that 2.5 acre feet is as much as the land will probably require under proper regulation of use and skillful application.

It should also be remembered that the quantity of water estimated as available is based upon an assumed loss of 36 per cent between the river and the lands.

This estimate of loss seems liberal, to say the least, and if it shall be found necessary to reduce the loss much can be accomplished by extending the concrete lining to unlined portions of the ditch.

It is proper, too, to call attention to the fact that the estimated quantity of water available is 2.5 acre-feet, or more, for 80 per cent of the entire District. It is hardly conceivable that a very large proportion of this area will be ready for irrigation for some years, and by the time that all is brought under irrigation much of those lands which are first to receive water will have reached a point where they will require less than the estimated quota, and further, drainage ditches will of necessity have been constructed, which will take up ground water and deliver it for irrigation on lands at lower levels, thus adding to the supply.

COMMENT.

There are some matters connected with construction of the works to which it seems proper to direct comment.

The diversion canal along the side of the Stanislaus River canyon is lined with concrete. In places where the excavation was in solid rock the lining was omitted on the side next the hill. The rock formation is stratified, the strata uptilted to a nearly vertical position, and it will probably be found that water will penetrate the seams and find an exit into the river below. This will not endanger the safety of the canal, but it will increase the loss of water.

The concrete lining is nominally four inches thick, and usually ten feet or more high, and is not reinforced. The hillside above the canal is steep and rocky and will shed rainfall rapidly, and but little provision has been made to collect the water and dispose of it. The backfilling behind the concrete lining will very likely become saturated and will exert sufficient pressure to break out the lining, should the saturation occur at a time when there is no water in the canal to exert a counter-pressure.

What provision has been made to collect the hillside runoff discharges

it into the canal instead of outside. This will undoubtedly increase the amount of sand and debris in the canal to be disposed of.

In deep cuts, particularly in tunnel adits, the slope has been made steep. In some places the material seems to have a tendency to slake under exposure to the air, and may fall into the canal in large masses.

The conditions above named seem to have been brought about thru the imperative need for restricting costs to a minimum owing to lack of funds. They are conditions that can, and ultimately will, be corrected when the District shall have become under working conditions, but in the meantime are likely to cause increase in operating and maintenance expenses.

VALUE OF WATER RIGHTS.

The value of a water right is exceedingly difficult to determine. In some portions of Southern California the value is held to be \$1,000 for a miner's inch for a continuous flow. This is equivalent to about \$69 for an acre foot of water. In other portions of the State water is sold as low as 60 cents an acre for all needed during the year, presumably $2\frac{1}{2}$ or 3 acre feet or more.

The Districts paid \$650,000 for the Tulloch properties, and as the ditch is nearly all discarded and will not be used the water right is all that was obtained of value in the purchase. It has been stated above that the Tulloch ditch carried about 40,000 acre feet a year. The price paid was in bonds, the market value of which is about 80. The cash price of the Tulloch water was then about \$520,000, or at the rate of \$13 an acre foot. The same rate applied to the 142,100 acre feet which it has been shown the District may have under its appropriation, including the Tulloch purchase, amounts to \$1,857,300. For reasons appearing to make it unnecessary to the purposes of the present valuations, the Commission has not included this figure in its general report on valuations of the present and proposed improvements.

VALUE OF THE DISTRICT'S WORKS.

The cost of a works, erected under adverse conditions, is not the true physical value of them, but rather the cost under normal conditions upon a cash basis for labor and materials would be a true value.

As stated hereinbefore, long delays and other reasons caused the construction of the works to greatly exceed the estimates upon which the first bond issue was made.

Some important changes in the plans making for better works added to the cost.

\$325,000 was paid for a half interest in the Tulloch properties. Administrative expenses were extended over a long series of years, making that item of expense much greater than had been anticipated.

These several causes so increased the cost of the works that the original bond issue of \$1,875,000 fell far short of completing the works, hence the new bond issue was made.

The actual value of the works as they stand may safely be stated to be not less than \$1,500,000.

The estimated cost of completing the works according to the amended and approved plans which have been described at some length herein is segregated as follows:

Constructing Woodward reservoir-----	\$ 790,000
Distributing canal system, embracing more than 380 miles of canals and ditches to deliver water to every 40-acre tract--	1,085,000
System of drainage ditches-----	85,000

\$1,960,000

Report compiled by

P. M. NORBOE,

Ass't State Engineer.

Signed by

W. F. McCLURE,

State Engineer.

PART II.

Organization, General Condition as to Indebtedness, Titles to Lands, Water Rights, and Valuations of Same.

ORGANIZATION.

The South San Joaquin Irrigation District is a quasi-municipal corporation organized under the Irrigation Act of March 31, 1897, and the several amendments thereto. The petition, signed in the manner required by the Act, was presented to the Board of Supervisors of San Joaquin County, March 1, 1909, which body, on March 22, 1909, resolved that the District should be organized. The boundaries were established, certain exclusions properly effected, and at an election held within the District, May 11, 1909, the District was authorized and officers elected. Finally, on May 24, 1909, the Board of Supervisors ordered and declared the District duly organized and its officers properly chosen. These facts were fully recited in "Matter of the bonds of the South San Joaquin Irrigation District," 161 Cal., 345 (Transcript on appeal), and the Court held the District properly organized as of May 24, 1909. The organization was validated also by an Act of the Legislature, approved March 1, 1911 (Statutes of California, Thirty-ninth Section, P. 262). The legal boundaries of the District have been hereinbefore presented.

The Commission is therefore fully satisfied with the organic foundation of the District. It has satisfied itself that the present holders of title or evidence of title are subject to the burden of lawfully issued bonds to the extent of verifying the fact of issuance of patents to all lands within the District. A careful examination of the records of the U. S. Land Office at Sacramento showed patents to have been issued and State patents confirmed in all cases except twenty-eight. These were subsequently found to have been regularly issued and recorded in the office of the County Recorder of San Joaquin County, except as to two cases, which have been excluded from the total lands within the District subject to valuation by this Commission.

OTHER INDEBTEDNESSES OF THE DISTRICT.

The entire bonded indebtedness incurred by the South San Joaquin Irrigation District consists of the two amounts, \$1,875,000 and \$1,960,000, aggregating \$3,835,000, recited in the resolutions of the Board of Directors requesting this report. There are, however, certain few prior indebtednesses incurred by School Districts within the Irrigation District which are hereafter summarized. The highway bonds affect the entire county. There are no municipal corporations within the District. The

Ripon Union High School District includes a portion of the Irrigation District, but has no bonded indebtedness. The following letter from the Auditor and Recorder of San Joaquin County correctly presents the bonded indebtedness of all school districts wholly or partially within the District:

(Copy of letter.)

Stockton, Cal., April 9th, 1913.

Mr. M. T. Farmer,
San Francisco, Calif.

Dear Sir:

Per your request I hereby submit the following, as outstanding bonds, affecting the South San Joaquin Irrigation District:

Name of Bond.	Date.	Amount.	No. Outstanding.	How Due.
Highway Improvement..... (San Joaquin County)	1909	\$1,890,000	1,850 at \$1,000	50 per year. Int. 5%
Escalon School.....	6-11-1904	2,500	12 at \$125	1 per year. Int. 6%
Van Allen	8-26-1912	8,000	20 at \$400	1 per year. Int. 6%
Ripon	1911	11,000	11 at \$1,000	1st bond payable in 1917. Int. 6%
Weston.....	1910	1,000	8 at \$100	1 per year. Int. 6%
Summer Home	6-6-1906	2,000	14 at \$100	1 per year. Int. 6%

Trusting that this is the information desired, I am,

Sincerely,

(Signed) JOHN D. MAXEY, Auditor and Recorder.

By C. H. CAMPBELL Chief Deputy.

SOUTH SAN JOAQUIN IRRIGATION DISTRICT'S RELATION WITH OAKDALE IRRIGATION DISTRICT.

These Irrigation Districts have entered into agreements affecting their relations in two particulars, namely, as to the construction of dam and divisions A and B of the irrigation system, together with the ownership of water rights, and secondly the discharge of obligations assumed by both of the Districts in the purchases from Consolidated Stanislaus Water and Power Company and San Joaquin Canal and Irrigation Company.

These agreements have been effected usually at joint Directors' meetings, each District separately ratifying the obligations imposed upon it at subsequent meetings of its individual Board of Directors. It was accordingly agreed at a meeting of the two Boards of Directors held September 28, 1911, that they would jointly maintain their water rights against all adverse claimants, sharing the expenses equally to that end; that the diversion dam (Goodwin Dam) should be built and should be paid for equally by the two Districts; that as the North Side works below the Goodwin Dam were to have an ultimate maximum capacity of 1,370 second feet, of which Oakdale Irrigation District should have 260 second feet, the operation and maintenance and apportionment of initial costs of this joint system should be borne in the percentage of 81 per cent to the South San Joaquin Irrigation District and 19 per cent to the Oakdale Irrigation District. On February 9, 1913, it was jointly agreed that each District might spill surplus water into the ditches of the other not exceeding in the aggregate 50 second feet of water.

The contracts with Consolidated Stanislaus Water and Power Company and San Joaquin Canal and Irrigation Company obligate each purchaser to assume the burden of contracts theretofore entered into by the

vendors or their predecessors in interest and their patron users of water. These obligations were divided between the two purchasers equally, the Oakdale District assuming the burden of all contracts excepting the so-called "Frankenheimer" contract, which the South San Joaquin Irrigation District undertook to discharge. Any necessary initial expenditures to supply these contracts were to be borne equally by the two districts excepting as to a certain "Gabel" contract, which the Oakdale Irrigation District assumed alone. The engineers for the South San Joaquin Irrigation District estimate that the maximum outlay required for the Frankenheimer Bros. under this agreement is \$9,000. The maximum required by the several contractors according to the estimates of the Oakdale Irrigation District engineers is \$3,550. Half of these expenses being apportioned to each district, the subject of this report is burdened to the extent of \$6,275, as per the engineer's estimates. The income from the Frankenheimer contract to the District is estimated at \$4,610 initially, with an annual rental of \$1.50 per acre for land actually irrigated thereafter. The contract is clearly a burdensome one.

RIGHTS OF WAY.

Exclusive of the rights of way obtained under the deeds from Consolidated Stanislaus Water and Power Company and San Joaquin Canal and Irrigation Company, and exclusive of the rights of way through the proposed Woodward Reservoir Site, the engineer's report shows the necessary rights of way for the main supply canal outside of the District itself to be 81,381 feet, all of which has been secured by deed, contract or condemnation, with the exception of 1,205 feet belonging to the "George L. Wright Estate," as to which the rights are in dispute. The several prices paid for these rights total the District \$10,478.80, and numerous incidental burdens have been imposed, such as construction of bridges, flumes, fences, etc., etc.

WOODWARD RESERVOIR.

Of the 4,080 acres necessary to be acquired the District has acquired 1,629.62 acres, at a cost of \$44,429.70, not including incidentals, such as attorney's fees, etc., etc. This is an average cost per acre of \$27.26, at which rate the entire reservoir for land alone will cost the District \$111,220.80.

The rights of way for the distributary system are not nearly so completely determined, as the necessity for doing so has not been so imminent, but this work is well under way, as witness the case of the main distributary canal. This canal is 64,150 feet in length, of which nearly one-half, namely, 31,243 feet, are under contract or have been acquired by deed, at a cost of \$4,550 in cash and additional obligations as to construction of bridges, etc. The prices paid have in many cases called for payment in bonds. The total acreage required by the distributary system within the district is 2,806.66, which, at a flat valuation of \$126,559, gives an aggregate value of these lands of \$355,320.35.

The total minimum cash value of rights of way (exclusive of the "Tulloch System") for the entire system may therefore be put down as not less than:

Main supply canal-----	\$ 10,478.80
Woodward reservoir-----	111,220.80
Distributary system-----	355,320.35
Total -----	\$477,019.95

MARKET VALUE OF THE LAND.

1. Scope of the inquiry. The statute provides that the Commission shall make or cause to be made an investigation and report upon (b) "the reasonable market value of the lands included within the boundaries of the district" (Statutes and amendments to the Code, Extra Session 1911, page 4). The phrase "Market value of the land" is repeated in Section 3 of the same Act. For the purposes of this report the Commission has assumed that the words "reasonable market value of the lands" as used in this act have the same meaning as the words "Cash value of real estate and city and town lots" found in Section 35 of the Irrigation Act of March 31, 1897, as amended March 19, 1909 (Statutes of California 1909, page 461), which are defined by the latter Act so as to include and exclude as follows:

1. Includes "the cash value of real estate other than city or town lots."

2. Includes "the cash value of city and town lots."

3. Excludes "improvements on any lands or town lots within such District shall be exempt from taxation for any of the purposes mentioned in this Act. The term improvements as used in this Section includes trees, vines, alfalfa and all growing crops and all buildings and structures of whatever class or description erected or being erected upon said lands or city or town lots."

It was found by the Supreme Court of the State, "Matter of the bonds of the South San Joaquin Irrigation District," 161 Cal. 375 (See Transcript on Appeal), that the Irrigation District was organized on the 24th day of May, 1909. The Act of 1909 above referred to went into effect May 19, 1909, and accordingly the proviso thereto that the provisions of the section relating to the exemption of improvements on land and town lots shall not apply to districts organized previous to the enactment of the amendment unless the provision shall be approved by a vote of the majority of the resident holders of titles to land situated within the district and subject to taxation thereto at a special election, had no effect upon South San Joaquin Irrigation District.

It has been therefore the purpose of the Commission to estimate the cash value of all real estate within the District, including that of city and town lots, and excluding all improvements of every character upon such land or town lots.

It may be remarked, that while the findings of the Assessor as to cash values as equalized by the Board of Directors of the District, sitting as a Board of Equalization, are not reviewable, there is no express provision in the Act of 1897 and its several amendments granting any discretion to such officers to fix such cash values in proportion to benefits received from the direct irrigation of lands from the irrigation system. (Act of 1897, Section 35 (as amended in 1909), Sections 36, 37, 38 and 39.)

It may be further remarked that, whereas, under the amendment to Section 78 of the Act of 1897, approved February 28, 1905 (Statutes 1905, page 27), any non-irrigable lands or lands irrigated from another system of irrigation works or lands subdivided into town lots or blocks, etc., etc., have a right to be excluded from the district in the manner provided for in this portion of the Act, such exclusion does not release the lands so excluded from the lien of any outstanding bonds unless the bondholders shall have assented to a release of such lien in the manner provided for in this section of the Act. (Sec. 79.)

It follows, therefore, that all the lands within the confines of the South San Joaquin Irrigation District (except roadways belonging to the

State, railroads not subject to local taxation under the Constitution of this State and lands owned by the District) are subject to the lien of bonds heretofore issued, and the extent of the lien to which they are so subjected is the "cash value" of such real estate and town property exempting improvements of the classes described as such "cash value" is found by the Assessor and the Board of Equalization.

LANDS VALUED.

The limits of the District include 71,050 acres of land. Of this amount 1,319.6 acres are consumed by highways and railways which are not subject to the lien of these bonds, 1,128.9 acres are found by the Chief Engineer to be non-irrigable, and 2,806.6 acres belong to the District, chiefly as easements for rights of way. As to non-irrigable lands, the commission has estimated their "real value" for purposes of taxation at \$10 per acre. There are also 325 acres of town lots included within the towns of Manteca, Ripon and Escalon. As to these the Commission has adopted the flat figure of \$600 per acre as the basis for taxation purposes. This figure necessarily excludes improvements. The Commission feels moved to add, however, that it has examined affidavits as to the transfers of 178 lots in these three towns and is convinced that the value of the town properties, including the improvements thereon, is more than nine times the figure fixed by itself as the valuation of the bare land. In explanation of this decision the Commission would call attention to the fact that while city lands are doubtless receiving the benefit indirectly which the District lands receive directly from the irrigation system, they are not direct users of such waters and have been excluded by the present District in its calculations for necessary waters and for cost of its distribution system. Deducting these four factors from the total acreage of the District leaves a remainder of 65,469.84 acres as to which the Commission has directed its attention with a view of determining a reasonable "market value" of lands exclusive of improvements.

The method pursued to reach this finding consisted of examination of two series of affidavits (88 in number) covering several hundred transfers of land made during the two years last past. All of these which covered improved property as defined above were excluded. The existence of improvements was verified by comparisons with the Engineer's plats of the District, and much effort was directed to accurately verify these affidavits.

The results of the affidavits not thrown out are appended in tabular form hereto.

UNIMPROVED REAL ESTATE.

SERIES NO. 1.

Aff. No.	No. of Acres.	Price Per Acre.	Total Value.
1 -----	19	\$125.00	\$ 2,375.00
1 -----	19	145.00	2,755.00
1 -----	19	125.00	2,375.00
1 -----	19	125.00	2,375.00
1 -----	80	135.00	10,800.00
3 -----	20	135.00	2,700.00
3 -----	50	100.00	5,000.00
3 -----	11.28	100.00	1,128.00
Carried forward -----	237.28	-----	\$29,508.00

Aff. No.	No. of Acres.	Price Per Acre.	Total Value.
Brought forward -----	237.28	-----	\$29,508.00
3 -----	20	100.00	2,000.00
3 -----	10	110.00	1,100.00
4 -----	320	140.00	45,000.00
6 -----	40	102.00	4,080.00
7 -----	132.47	125.00	33,117.50
7 -----	154	108.00	16,632.00
7 -----	25	118.00	2,950.00
7 -----	25	112.00	2,800.00
7 -----	120	118.33 1-3	14,200.00
8 -----	478	140.00	66,920.00
11 -----	50	120.00	6,000.00
11 -----	40	100.00	4,000.00
12 -----	40	130.00	5,200.00
14 -----	47	100.00	34,700.00
14 -----	240	100.00	24,000.00
14 -----	100	100.00	10,000.00
14 -----	40	114.50	4,580.00
14 -----	6.35	140.00	889.00
15 -----	157	103.00	16,171.00
15 -----	9.74	125.00	1,217.50
15 -----	60	100.00	6,000.00
15 -----	20	110.00	2,200.00
15 -----	90	105.00	9,450.00
15 -----	11.03	154.00	1,698.63
15 -----	20	105.00	2,100.00
16 -----	27.75	105.00	2,913.75
16 -----	50	120.00	6,000.00
16 -----	40	95.00	3,800.00
16 -----	155	110.00	17,050.00
17 -----	38.3	125.00	4,787.50
18 -----	40	105.00	4,200.00
20 -----	40	125.00	5,000.00
20 -----	20	125.00	2,500.00
27 -----	147.07	125.00	18,383.75
27 -----	5.15	150.00	775.50
29 -----	40	125.00	5,000.00
30 -----	50	100.00	5,000.00
31 -----	1,231	*100.00	123,111.00

*\$100.00 bid; \$150.00 asked.

SERIES NO. 2.

7 -----	40	\$200.00	\$ 8,000.00
35 -----	40	100.00	4,000.00
39 -----	40	100.00	4,000.00
38 -----	250	160.00	40,000.00
40 -----	20	125.00	2,500.00
41 -----	60	150.00	9,000.00
42 -----	20	150.00	5,000.00
52 -----	40	125.00	5,000.00
52 -----	20	100.00	2,000.00

Carried forward -----	4,901.14	-----	\$624,535.14
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Aff. No.	No. of Acres.	Price Per Acre.	Total Value.
Brought forward	4,901.14	---	\$624,535.14
52	25	225.00	5,625.00
43	24.61	225.00	5,537.25
13	120	65.00	7,800.00
13	20	85.00	1,700.00
11	110	100.00	11,000.00
9	160	185.00	14,280.00
9	10	125.00	1,250.00
8	40	90.00	3,600.00
---	53	75.00	3,975.00
---	20	150.00	3,000.00
51	20	100.00	2,000.00
50	400	110.00	44,000.00
30	66	125.00	8,250.00
36	45.50	87.91	4,000.00
35	40	222.5	8,900.00
34	32.6	114.06	6,000.00
34	258	100.00	25,800.00
34	10	125.00	1,250.00
33	43	209.30	9,000.00
32	42	202.38	8,500.00
32	60	166.66	10,000.00
31	40	100.00	4,000.00
28	60	154.16	9,250.00
28	20	237.5	4,750.00
28	10	120.00	1,200.00
27	160	93.75	*15,000.00
Totals	6,545.87		\$828,702.38

Total Acreage, 6,545.87; Average Value per acre \$126.559; Total Value, \$828,702.38.

*\$15,000 refused; \$17,000 asked.

The aggregate valuation of the land for this report is therefore found by the Commission to be as follows:

1,128.9	acres non-irrigable at \$10 per acre	\$ 11,289.00
325	acres town lots at \$600 per acre	195,000.00
65,469.84	acres at \$126.599 per acre	8,288,416.27
Total		\$8,494,705.27

WATER RIGHTS.

The title of the South San Joaquin Irrigation District to water rights on the Stanislaus River and Little John Creek is based upon appropriation. The appropriations depended upon will be discussed under the following two heads:

1. Appropriations made by or for the District.
2. Prior appropriations purchased by the District.

1. Certain appropriations hereafter enumerated have been begun or made by and on behalf of the South San Joaquin Irrigation District. It is upon these coupled with a prompt and diligent prosecution of its system of irrigation works and at the date of this writing the beginning of an actual user that the District chiefly relies for its water rights. The Commission finds these appropriations to be as follows:

"a. On September 12, 1907, F. M. Cowell gave notice of a claim to water from the Stanislaus River in the County of Calaveras to the extent of seventy thousand inches measured under a four-inch pressure for the purpose of irrigation, domestic and power uses, and intended for use in the Counties of San Joaquin and Stanislaus on the land adjacent to and along the northern bank of the Stanislaus River and in the vicinity of Manteca; the point of intended diversion being about a quarter of a mile above what is known as 'Six Mile Bar' or the old dam site of 'Stanislaus Water and Power Company' in the County of Calaveras. This notice was recorded September 19, 1907, in Book A of Water Rights, page 389, Calaveras County records, and on September 16, 1907, in Book 1, volume 2, page 158 of claims Tuolumne County Records.

"b. F. M. Cowell on the 15th day of July, 1908, filed a notice of claim of water at a point a quarter of a mile above what is known as 'Six Mile Bar' on Stanislaus River, flowing in the channel of the Stanislaus River to the extent of fifty thousand inches measured under a four-inch pressure, the claim being for the purpose of irrigation and domestic use on lands in the County of San Joaquin, State of California, and particularly described as being in the immediate vicinity of Escalon, Manteca and Ripon in said County, and incidentally for the generation of power. This notice describes the intended dam explicitly and the certificate was recorded July 20, 1908, in Book 1, volume 2 of claims at page 250, Tuolumne County Records.

"c. F. M. Cowell by an instrument in writing dated September 14, 1909, duly acknowledged, assigned all his rights and claims of every kind derived under the above described notice of appropriation dated July 15, 1908, and particularly his right to divert and use the water flowing at the point of diversion in the Stanislaus River described to the extent of fifty thousand inches measured under a four-inch pressure to South San Joaquin Irrigation District. The instrument recites that the appropriation was made for and on behalf of the South San Joaquin Irrigation District, organization of which was at the date of the said claim contemplated. This assignment has been recorded in Tuolumne County, September 29, 1909, in book A, volume 67, page 621 of deeds, Tuolumne County Records.

"d. South San Joaquin Irrigation District by B. A. Goodwin gave notice of a claim of water in the Stanislaus River at 'the place about five miles above Knight's Ferry known as the Cowell Dam Site in Northeast quarter of section 11, Tp. 1 S., R. 12 E., M. D. B. & M.' to the extent of sixty thousand inches measured under a four-inch pressure on the 3rd day of September, 1909. The purposes for which the water was claimed were irrigation and domestic uses for lands in San Joaquin County particularly within the boundaries of South San Joaquin Irrigation District. The notice is in statutory form, but unacknowledged though recorded in Tuolumne County, September 8, 1909, in book 1, volume 11, page 370 of claims.

"e. South San Joaquin Irrigation District by B. A. Goodwin, President, on the 20th day of December, 1909, gave due notice of its claim to flood waters in the Stanislaus River in addition to waters theretofore appropriated by said District to the extent of one hundred and fifty thousand inches measured under a four-inch pressure; the point of intended diversion being near what is known as 'Cowell's Dam Site' in the County of Calaveras and near what is known as 'Cowell's Dam Site' in the County of Tuolumne. The purpose of the intended diversion and of the claim is recited as that of supplying a reservoir or reservoirs for a portion of its

system to be thereafter constructed and intended for irrigation and other purposes authorized by the Irrigation Act of 1897 specifically referred to in the notice. A copy of this notice, unacknowledged, was recorded December 24, 1909, in Book A of Water Rights, page 1259, Calaveras County Records, and December 27, 1909, book 1, volume 11, page 410 of claims, Tuolumne County Records."

2. By deed dated April 28, 1910, South San Joaquin Irrigation District acquired from "San Joaquin Canal and Irrigation Company" and "Consolidated Stanislaus Water and Power Company" an undivided half interest in all the rights, assets and properties, both real and personal, owned or controlled by the latter two corporations (by warranty deeds), saving and accepting certain physical properties belonging to the vendors and a right to the use of waters of the Stanislaus not required by Oakdale and South San Joaquin Irrigation Districts. These deeds were duly recorded in the Counties of San Joaquin, Stanislaus, Tuolumne and Calaveras and on the same date thereof similar deeds were executed by the same companies to Oakdale Irrigation conveying to the latter District the remaining undivided one-half interest in the same properties. The price paid by each district to the corporations was \$325,000.

The clause of the several deeds descriptive of the water rights conveyed reads as follows:

"All right, title, interest, claim and possession of said first party in and to all of the waters of Stanislaus River, including the natural, normal, flood, storm, reservoir and riparian flow thereof and all future water impounded by any person, firm, or corporation, other than the party of the first part, its successors or assigns, together with all water, water rights, appropriations and all rights of use and diversion."

It becomes important to determine the rights of the Consolidated Stanislaus Water and Power Company and San Joaquin Canal and Irrigation Company to the use of the water of the Stanislaus River prior to the execution of the above deeds. For this purpose the Commission has caused an examination to be made of abstracts of the records in Stanislaus, Tuolumne, Calaveras and San Joaquin Counties covering the years December 12, 1855, to August 23, 1910, with a view to determining what right, if any, to the use of water had been acquired by these two companies. The significant features of these abstracts may be briefly presented here.

"The records of the County of Calaveras disclose that in 1855 San Joaquin Water Company owned 'the dam across the Stanislaus River and the ditch or canal leading from said dam to the county line westerly from Knight's Ferry, which dam is the corporate property of said company, said ditch being now nearly completed.' This property was that year mortgaged by a mortgage subsequently assigned to Abraham Schell, who, together with other creditors of the company, brought foreclosure on a mortgage dated March 8, 1859. On December 16, 1863, lis pendens was filed, but the determination of this suit is not indicated by the abstract of the records. From June 25, 1867, to October 7, 1887, abstract discloses no instrument affecting this water right or property excepting a patent by the United States Government to A. B. Preston, George Hearst and James G. Haggin, dated January 31, 1883. On the later date above named, however, Abraham Schell gave notice of a claim of water right to the extent of 100,000 inches measured under a four-inch pressure for the purpose of mining, irrigation, agriculture and water power and for the use of cities and villages, particularly of Stockton, to be diverted by 'an enlargement of the San Joaquin County ditch to the width of fifty feet and the depth of six feet.' There had, however, prior to this date been recorded a notice of appropriation by M. F. Tarpey and John Gambetti, dated June 3, 1887, or

rather of a series of notices of appropriations of this date. The amount claimed was 350,000 inches measured under a four-inch pressure and the points of diversion varied from six miles to four and one-half miles above the village of Knight's Ferry. Similarly a notice of appropriation had been made by L. U. Shippee and John A. Morrissey, dated June 22, 1867, and repeated October 8, 1887, under which they claimed 300,000 inches under a four-inch pressure for similar purposes, the point of diversion being 'by a dam to be built across the Stanislaus River near the place of posting of this notice.' Gambetti deeded his interest to Tarpey September 28, 1887; Tarpey, Shippee and Morrissey deeded their several rights and claims to 'San Joaquin Land and Water Company' July 18, 1888.

San Joaquin Land and Water Company had filed its articles of incorporation in the office of the County Clerk of Calaveras County January 26, 1888. On April 17, 1888, this company gave notice of a change of the place of diversion of waters of the Stanislaus River, in which notice they recited the several appropriations by Tarpey and Gambetti, by Shippee and Morrissey, and by Abraham Schell and continuing 'that the undersigned corporation has become the owner of said claims and rights.' The corporation now claimed two hundred thousand inches measured under a four-inch pressure and the point of diversion is described as changed from all of those recited in the notices referred to to 'a point on said Stanislaus River on the right side of the same going down forty-six hundred feet below a dam of the San Joaquin Ditch Company on said river known and called the Schell Dam.'

"It nowhere appears of record how Abraham Schell disposed of his interest in the earlier 'San Joaquin Water Company' and his subsequent notice of appropriation, although the deed by Tarpey, Shippee and Morrissey to San Joaquin Land and Water Company has a reference to 'the conditions as to furnishing water to persons at Knight's Ferry and vicinity contained in the deed from Abraham Schell and others to the said Shippee and Morrissey.'

"The deed by Tarpey, Morrissey and Shippee was executed and recorded June 15, 1892, in Book A of Deeds, volume 75, page 419, San Joaquin County Records. On December 7, 1894, San Joaquin Land and Water Company sold to H. W. Cowell all its physical properties, also all their riparian rights to certain lands excepted from the deed and all the rights to waters of the Stanislaus appropriated by the filings of Tarpey, Gambetti, Morrissey and Schell, as well as to the waters of Little John Creek and French Camp Slough, appropriated by Tarpey and Gambetti.

"For the purpose of operating this ditch the 'Stanislaus and San Joaquin Water Company' was organized, the articles of incorporation of which were filed in the office of the Secretary of State October 20, 1894, and H. W. Cowell and N. F. Harold conveyed to this corporation by deed dated December 12, 1894, the same property which Cowell had acquired from San Joaquin Land and Water Company with some variations as to descriptions. The latter deed also contains the following clause not found in the former deed: 'This conveyance is made subject to the conditions set forth in the said deed of Schell to said San Joaquin Land and Water Company.' This deed is substantially duplicated by another dated June 14, 1895.

"On July 25, 1895, Stanislaus and San Joaquin Water Company mortgaged to California Safe Deposit and Trust Company, trustees, by a deed of trust, all its properties, including its contracts with patrons, and this mortgage was from time to time supplemented so as to include subsequently acquired rights of way and agreements, which deed of trust was foreclosed for a sum aggregating \$91,623.25, the judgment having been

docketed December 28, 1898. Oscar F. Atwood, as commissioner, sold all these properties to J. Dalzell Brown, who assigned the certificate of sale to R. Bigelow, the latter assigning to 'Stanislaus Water Company' July 5, 1899.

"Stanislaus Water Company, of which Charles C. Tulloch was one of the original directors and subscribers to capital stock, was incorporated June 29, 1899. A deed dated July 6, 1899, by Oscar F. Atwood, as commissioner, to Stanislaus Water Company grants, bargains, sells and conveys to the latter all the physical properties described in the deed from San Joaquin Land and Water Company to H. W. Cowell of 1894, including the former's water rights.

"On February 1, 1907, Stanislaus Water Company conveyed to Consolidated Stanislaus Water and Power Company its physical properties and its water rights in the following language: 'All that certain right to the use of the water flowing in the canal known as Stanislaus Water Company's canal, which is diverted from the Stanislaus River by the dam of the party of the first part, situated at 'Six Mile Bar,' together with the rights of said second party to maintain said dam as it now exists, etc.' This latest company was incorporated February 18, 1907, Charles S. Tulloch being among its first directors. Finally San Joaquin Canal and Irrigation Company is a party to certain agreements with the stockholders of Consolidated Stanislaus Water and Power Company and described as the 'new company' in a stockholders' agreement entered into by the stockholders of the latter company April 1, 1908, and recorded in San Joaquin County August 17, 1909. There is no copy of the articles of incorporation of the former company nor of any deed from the Consolidated Stanislaus Water and Power Company to it, but as both these companies have conveyed all of their interests by warranty deed to Oakdale Irrigation District and South San Joaquin Irrigation District this ellipsis is regarded as immaterial."

It has been repeatedly held by the Supreme Court of this state that an appropriation, regardless of the claim contained in his notice of appropriation, obtains a right good against subsequent appropriators to that amount of water and only that amount which he provides a means of diverting from the stream within a reasonable time. In his report to the Modesto Irrigation District on "Stanislaus River as a source of supply," dated at Sacramento, November 17, 1887, Mr. C. E. Grunsky reports on the extent of the San Joaquin County Company's diversion at that time in the following language:

"San Joaquin County Ditch is the lowest ditch on the north side of Stanislaus River. It supplies water to miners and gardens near Knight's Ferry. The head of this ditch is about seven miles above Knight's Ferry on the right bank of Stanislaus River.

"At its head it is exposed to injury by the high waters of the river because the ditch is but slightly elevated above the waters of the river. For a considerable distance the ditch, which is a small one, generally about six feet wide on top, skirts the talus of basalt and the lava debris on the face of the canyon bluff. It has a long course down the canyon and for about three-quarters of a mile is carried in a flume, of which about one-fourth mile is a hanging flume made fast to a vertical wall of cobble, conglomerate and lava."

"The greatest capacity of this ditch is about thirteen cubic feet per second. A small amount of this water is carried into the valley of Little John Creek. Most of it is used in the immediate vicinity of Knight's Ferry.

"This ditch was constructed in 1855 by the San Joaquin County Water company. After many financial troubles, in which the owners of the ditch became involved it fell into the hands of its present fourteen owners, most of whom are consumers of its waters.

"This ditch has an old established right to water and so long as the ditch is maintained this right will take precedence over that of the Modesto District, but this is true only to the extent of the present ditch capacity, which is so small that diversion of the water will never prove seriously detrimental to the interest of the district."

Converted into terms of miners' inches, in which the notice of appropriation is figured, the ditch's maximum capacity, according to this report, at that time was only 520 miners' inches of water.

The following table, showing a maximum discharge of water by Stanislaus and San Joaquin Water Company's ditch, is taken from statistics presented in Water Supply Paper 299, page 328, issued by the United States Geological Survey of the Department of Interior:

	Second Feet.	Miner's Inches.
July 22, 1904 -----	105	4200
May 23, 1905 -----	114	4560
July 1, 1906 -----	132	5280
June 15, 1908 -----	102	4480
May 28, 1912 -----	102	4480

The measurements were made near Knight's Ferry and consequently do not include the amount carried in the "Schell Ditch," which "diverts a small quantity of water from the main canal" of Stanislaus and San Joaquin Water Company's works "at some distance below the intake." The maximum capacity of this co-called "Schell Ditch" is given by the same authority as from 6 to 10 second feet, or 240 to 400 miner's inches. The same authorities also give the mean discharge of the canal for May, 1898, as 70.8 second feet, or 2832 miner's inches.

From this set of figures it will therefore be seen that the largest flow of water reported for this system during these years (1899-1912) does not exceed 6000 miner's inches. As the capacity of the combined head works of Oakdale and South San Joaquin Irrigation District's systems is 1700 second feet, or 68,000 miner's inches, at least approximately 91 per cent of the water right necessary to these two systems must be depended upon from other sources than the purchase of the so-called "Tulloch" water rights.

The Commission has not been supplied with any information as to water rights acquired by Oakdale Irrigation District independent of the appropriation of the South San Joaquin Irrigation District and the purchase of the "Tulloch" system. It will be noted from the above summary of appropriations that neither the appropriation of the "Tulloch" system nor of the South San Joaquin Irrigation System directly cover diversions for lands south of the Stanislaus River. The Oakdale Irrigation System has by virtue of its agreement with the South San Joaquin Irrigation District a maximum right of 260 second feet, or 10,400 miner's inches, of water to be delivered north of the Stanislaus. This alone added to the 34,000 miner's inches necessary to the maximum present capacity of the South San Joaquin Irrigation District system gives a total of 44,400 miner's inches of water intended to be diverted by the combined systems for the irrigation of lands north of the Stanislaus River. It will be observed that this amount is well within the 50,000 miner's inches of water claimed by F. M. Cowell in his appropriation of 1908, subsequently

assigned to the South San Joaquin Irrigation District, which claim of water has been supported by reasonable diligence in the construction of the irrigation works. Disregarding then entirely the rights acquired from the so-called "Tulloch" system, the South San Joaquin Irrigation District has from this appropriation a claim to all the water which may be diverted through its canal to its own lands and that of the Oakdale Irrigation District north of the Stanislaus River.

It has heretofore been stated that the two districts have entered into an equal partnership agreement in the ownership of water rights in the Stanislaus River. It is assumed therefore for the purpose of this report that Oakdale Irrigation District has acquired rights sufficient to support this agreement in relation to lands to be irrigated south of the Stanislaus River, independent of the "Tulloch" rights and the appropriations made by the South San Joaquin Irrigation District above set out. It is therefore evident that if the appropriations of the District acquired through the Cowell claim are good as to 44,400 miner's inches of water, the present maximum capacity of the South San Joaquin Irrigation District system is satisfied.

The portion of this report dealing particularly with the question as to the amount of water in the Stanislaus River available for diversion by this system shows that at the date of the Cowell appropriation there was available for that purpose unappropriated water sufficient for the purposes of both the South San Joaquin and Oakdale Irrigation Districts, assuming that the Oakdale District diverts the same amount of water as that diverted by the South San Joaquin. That portion of the report also shows that the capacity of the South San Joaquin Irrigation District system, namely, 34,000 miner's inches at its maximum flow, is adequate for supplying the reasonable needs of the South San Joaquin District. It is therefore the conclusion of this Commission as to the sufficiency of its water right that the South San Joaquin Irrigation District has acquired under the Cowell appropriation of 1908 rights to the use of sufficient water for the purpose of its irrigation system. A sufficient amount of water was unappropriated in 1908, a sufficient amount of water with a reasonable margin was claimed by the Cowell appropriation referred to, and the district will become an actual user to this extent within a time reasonably immediate subsequent to the date of that notice of appropriation. Its title therefore to this amount of water from its source is considered as good. In making these statements the Commission is aware that certain prior diversions have been made upon the Stanislaus River and that the aggregate of the claims far exceeds the entire flow of the river. The above statement is also made with the full appreciation of the possibility of some such prior diverting appropriation or lower riparian owner contesting the rights of the South San Joaquin Irrigation District to this water. But the fact that the water was not in use in 1908 and prior thereto, that nearly five years have elapsed since that date, and that in that interval the claims of the District have not been attacked by adverse claimants is regarded by the Commission as establishing a substantial right on the part of the South San Joaquin Irrigation District to a title to not exceeding 44,400 miner's inches of water under the F. M. Cowell appropriation of 1908. This right plus the earlier and well established right acquired under the "Tulloch" system to some 6,000 miner's inches of water the Commission is of the opinion establishes the title of South San Joaquin Irrigation District as reasonably good to the water in question to a maximum amount not exceeding the capacity of the District's system.

There are attached hereto certain opinions of Mr. L. L. Dennett, at-

torney for the South San Joaquin Irrigation District, relating to the water rights possessed by the district.

Report for Part II, compiled for the Commission by Milton T. Farmer.
Signed May 13, 1913.

(Copy)

April 10, 1913.

Dear Sir:—

You are advised that prior to the purchase by the South San Joaquin Irrigation District of the so-called "Tulloch" properties and water rights on the Stanislaus River, and prior to the issuance of bonds, I carefully examined the title of the district to the water rights claimed by it.

Such examination was based upon the following sources of information, viz:

A report by C. E. Grunsky, Civil Engineer, to the Modesto Irrigation District in 1887 upon the Stanislaus River as a source of supply for the irrigation of the Modesto Irrigation District, a copy of which report is attached hereto.

A very voluminous abstract of the title of the San Joaquin Canal & Irrigation Company and Consolidated Stanislaus Water & Power Company to the waters of the Stanislaus River, which abstract has heretofore been filed in your office.

A personal investigation, somewhat hastily made, of the actual diversions upon the Stanislaus River.

I ascertained that the diversions apparently had not been changed materially from those mentioned in the report of Mr. Grunsky, and that, subject to such appropriations, the South San Joaquin Irrigation District, by the acquisition of the so-called "Tulloch" properties, and by its own appropriation had acquired a right, jointly with the Oakdale Irrigation District, to divert from the Stanislaus River all of the waters thereof to the extent of its appropriation.

The abstract of the "Tulloch" properties showed the original appropriation and a continuous chain of title down to the date thereof as to the amount of water actually used by the companies owning such rights.

My opinion as to the rights of the South San Joaquin Irrigation District is based rather upon its appropriation, however, than upon its acquisition of the so-called "Tulloch" properties. The purchase of the "Tulloch" properties was rather for its moral effect to remove any possible opposition, as that was the only right of any importance at the time upon the Stanislaus River.

Since the date of its appropriation the district has pushed the completion of its appropriation with all possible rapidity, and there have been no intervening rights or filings.

As you will notice from the notices of appropriation filed with you, in addition to its appropriation of the normal flow, the district has made an appropriation of the storm or flood waters for the purpose of storing the same in its reservoir for later irrigation.

The district has an agreement with the Oakdale Irrigation District for an equal division of the water appropriated. This agreement, however, in my opinion, applies merely to the actual diversion during the period of diversion and not to any division of the stored water. In fact, such division would not be possible, as the waters are stored below the point of diver-

sion, and below a point from which the Oakdale Irrigation District could make any use.

Very truly yours,

L. L. DENNETT.

Mr. M. T. Farmer, Care Superintendent of Banks, 704 Postal Telegraph Bldg., San Francisco, Calif.

(Copy)

April 21, 1913.

Dear Sir:

Referring to your letter of April 15th, relative to the water rights of the South San Joaquin Irrigation District, I am referring your letter to the Secretary with the request that he endeavor to procure for you a transcript of the filings referred to. The opinion which has heretofore been given I think is as complete as can be given. The report of Mr. Swickard shows fully, particularly together with the report of Mr. Grunsky, the actual diversions on the river. As you are aware, one of the chief amusements of the people residing in these mountain counties the past twenty-five years has been to file notices of water appropriations, and I presume that all of the water of the Stanislaus River has been appropriated very many times so far as the notices go, but since the notice is not effective unless an actual diversion has been made, no attention was paid by the district or by myself to the notices of appropriation. Prior to the purchase of the so-called "Tulloch" properties by the district, the appropriations from the river for a period of over ten years had been negligible, and when the district acquired the so-called "Tulloch" properties it acquired what was practically a prior right to the diversion of water from the Stanislaus River. The San Joaquin county ditch, referred to in the Grunsky report, was included in the "Tulloch" properties. The Knight's Ferry Mill, also referred to in the Grunsky report, had its right merged into the "Tulloch" properties.

Yours very truly,

L. L. DENNETT.

Mr. M. T. Farmer, Care Supt. of Banks, 704 Postal Telegraph Bldg., San Francisco, Calif.



